JANUARY, 1933.

GENERAL PHYSICS.

ADSORPTION.

1. Adsorption of Paraffin Vapours on Water: Significance of Traube's Rule. H. Cassel and M. Formstecher. *Kolloid Zeits.* 61. *pp.* 18–26, *Oct.*, 1932.—The curves connecting the surface tension of water (π) towards the vapours of *n*-butane, *n*-hexane and *n*-heptane with the vapour pressure (p) at 0° and 12° C. are convex towards the pressure axis. This behaviour is opposed to that of the corresponding fatty acids and must be explained by the predominance of an attraction member in the equation of state; addition of the term $a\pi^2$ brings the equation into approximate agreement with the curve. The requirement of the surface is supplied satisfactorily by the assumption of paraffin molecules lying flat. It follows that the π-p curves may be represented by the equation $\log p = A + \log \pi + \frac{\beta\pi}{2\cdot 3RT} - \log(1 + a\pi)$. The solubility of the paraffins in the adsorption layer is only limited, and in equilibrium with the volume phase only an expanded film forms, in correspondence with the preponderance of cohesion forces. The heats of adsorption calculated approximately from the temperature coefficients for higher surface densities have the order of magnitude of the heats of condensation. From the values of A corresponding with the initial slope of the π-p curves, the differences between the initial heats of adsorption are calculated. In the sense of Langmuir's views, the adsorption of the paraffins confirms Traube's rule, owing to increase of the polarisability with the chain-length. For adsorption from solution, comparison of the paraffins with the corresponding fatty acids or alcohols gives, however, an explanation of Traube's rule which differs from that of Langmuir. T. H. P.

2. Adsorption of Gases on Solids. R. S. Bradley. *J. Phys. Chem.* 36. *pp.* 2674–2682, *Oct.*, 1932.—A mathematical paper, in which certain aspects of adsorption concerned with the relation between the surface and bulk phases are discussed under the headings: application of the " Morse curve " to adsorption, the unimolecular film, correction for the finite size of the adsorbed molecules, the formation of agglomerates on the surface and activated adsorption. T. H. P.

3. Adsorption of Carbon Dioxide, Ethylene and Hydrogen on Pyrophoric Iron and Powdered Gold. A. Magnus and R. Klar. *Zeits. f. phys. Chem.* 161. *Abt.A.* 4–5. *pp.* 241–254, *Sept.*, 1932.—The adsorption isotherms of carbon dioxide and ethylene on powdered gold and of ethylene on active pyrophoric iron have been determined at 0°, 20° and 40° C. The isotherms for hydrogen on these metals were not reproducible. The gold isotherms were not very different from those obtained for the same gases when adsorbed on charcoal. The iron isotherms were very different, from which it is concluded that iron possesses active centres with a very high adsorption potential. It is noted also that the iron is much more active catalytically for hydrogen reactions than gold. F. J. W.

4. Heats of Adsorption of Hydrogen and Carbon Monoxide on Copper. R. A. Beebe. *Faraday Soc., Trans.* 28. *pp.* 761–765, *Oct.*, 1932.—Using a single thermocouple in direct contact with the copper, the heats of adsorption of H_2 and CO have been measured. The adsorption of the initial portions of the CO does not occur uniformly throughout the catalyst mass. The adsorption of H_2 over the whole range and that of CO for the later portions is approximately uniform, and within the limits of experimental error the heats of adsorption are independent of the amount of gas adsorbed. F. J. W.

5. Swelling of Charcoal. Part II. Expansion Due to Water, Benzene and Pyridine Vapours. D. H. Bangham, N. Fakhoury and A. F. Mohamed. *Roy. Soc., Proc.* 138. *pp.* 162–183, *Oct.* 1, 1932.—The description is given of an apparatus suitable for measuring the quantities of volatile liquids adsorbed by a charcoal rod, and for determining the expansion resulting therefrom. The results of various experiments with a natural pinewood charcoal in contact with the vapours of benzene, pyridine and water are discussed in terms of the hypothesis [see also Abstract 1702 (1931)] that the expansion is a measure—either exact or approximate—of the pressure in the surface phase. On the basis of this hypothesis it is shown that the Gibbs equation is approximately valid over a considerable range of pressure in the case of benzene and pyridine, but not in that of water vapour. At low pressures the primary adsorption of benzene and pyridine to form gaseous films is accompanied by a secondary process associated with a contraction of the charcoal. At temperatures between 0° and 25° C. the molecular expansion curves for water adsorbed on one of the charcoals used are similar to the *pv* curves of a vapour undergoing condensation by isothermal compression. The surface phase is, however, more readily condensible at higher than at lower temperatures. At $-30°$ C. the surface vapour phase condenses to form a solid film. Some effects of the presence of gaseous impurities are described and discussed. H. H. Ho.

6. Adsorption and Capillary Condensation. G. Lindau. *Kolloid Zeits.* 60. *pp.* 253–263, *Sept.*, 1932.—Reference is made *inter alia* to the work of Polanyi, Lowry, Zsigmondy and co-workers. It is shown from the measurement of Coolidge as well as Goldmann and Polanyi that the curves for equivalent pressures of two vapours or one vapour at two temperatures which are independent of the adsorbents for the widest isotherm region from the smallest coating to that approaching saturation are linear curves. The inclination of the curves is independent of the adsorbens. They are clearly different from those to be expected from the theory of capillary condensation, but appear to be in closer agreement with the deductions of the potential theory. J. K.

See also Abstracts 47, 245, 364.

ATOMIC AND MOLECULAR STRUCTURE.

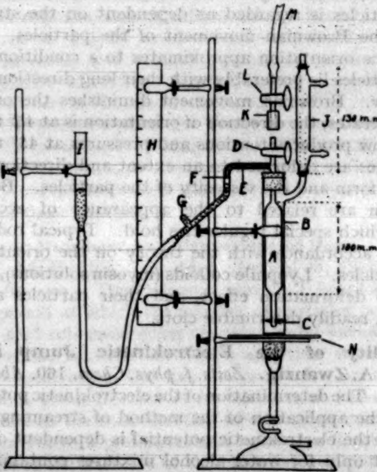
7. New Isotopic Effect. L. Goldstein. *Comptes Rendus,* 195. *pp.* 703–706, *Oct.* 24, 1932.—An isotopic effect in the Raman spectrum is predicted and a brief theoretical discussion is given. The magnitude of the effect is of the same order as that observed in the rotation-vibration bands of isotopic molecules. W. D. W.

8. Quantum Mechanics of the Water Molecule. A. S. Coolidge. *Phys. Rev.* 42. *pp.* 189–209, *Oct.* 15, 1932.—The perturbation method of

Heitler and London has been applied to study the interaction of the atoms in the water molecule. For a preliminary calculation an arbitrary internuclear distance has been assumed, and no ionic wave function has been considered. The calculated binding energy, 3·5 volts, is too small, as was to be expected. An analysis of the sources of this energy in various types of resonance or electron interchange is developed, and the results compared with Slater's simplified model. Methods for the evaluation of electron reactions involving three centres are described, including a possible alternative for the customary Neumann method, applicable to two-centre problems. Formulæ for products of bi-axial surface harmonics and their integrals are given. AUTHOR.

9. Revised Atomic Weight of Silicon. P. F. Weatherill and P. S. Brundage. *Am. Chem. Soc., J.*, 54. *pp.* 3932–3938, *Oct.*, 1932.—Silicon tetrachloride, carefully purified by repeated distillation through efficient fractionating columns, in a vacuum in an all glass apparatus was hydrolysed with a pure HCl solution, and the ratio $SiO_2 : SiCl_4$ determined. The mean of eight analyses gave the value Si = 28·103 ± 0·0027. AUTHORS.

10. Molecular Weight Micro-Method. A. C. Bratton, Jr., and H. L. Lochte. *Indust. and Engin. Chem.* (*Analytical Edition*) 4. *pp.* 365–367, *Oct.* 15, 1932.—The method is a modification of that of V. Meyer. The apparatus is shown in the figure. It is essentially an inner jacket, A, fitted with a mercury manometer; the inner jacket is surrounded by an outer jacket, B, to maintain constant temperature during a determination. The outer jacket is constructed from a 25-mm. pyrex test tube, a 200-mm. side arm, J, of 5-mm. tubing being fused on as shown to serve as a condenser for the vapours of the heating medium. The inner jacket is made from a 15 by 150 mm. test tube. A 40-mm. length of 4-mm. tubing is fused to the bottom of the test tube, and three short lengths of thin rod, C, are sealed equidistantly around the circumference of the tube about 10 mm. from the



sealed end. These rods should be of such length that the inner jacket will be centred in the outer jacket when the apparatus is assembled. A 50-mm. length of the 4-mm. tubing is fused to the upper end of the test tube. A pyrex stopcock, D, which has a bore of 1·5 to 2 mm., is sealed to the upper end of the inner jacket. A short distance below the seal an 80-mm. length of capillary tubing, E, of 0·5 mm. bore is sealed to the inner jacket, and the end bent downward, as shown. A 100-mm. length of 5-mm. tubing is fused to the end of the capillary with a neat joint at F. A short length of 5-mm. tubing, G, is fused to the manometer arm, as shown, and sealed off to a 15-mm. length. This trap serves to retain any air bubbles that may rise up the manometer tube. A reference mark for the mercury in the manometer is etched around the side arm about 4 mm. below seal F, as shown. Before use, the inner jacket is filled with water to the reference mark to ascertain the volume of the inner jacket. The authors quote some determinations made with samples weighing about 5 mg. in 20 min. with an error not exceeding 2·5 %. E. E. F. d'A.

See also Abstracts 20, 24, 42, 250, 256, 359, 380.

COLLOIDS.

11. Orientation and Deformation of Disperse Particles in Streaming Liquids. W. Haller. *Kolloid Zeits.* 61. *pp.* 26–41, *Oct.*, 1932.—A theory on this subject is developed. The orientation of anisodimensional particles is regarded as dependent on the streaming of the liquid and on the Brownian movement of the particles. If the former predominates, the orientation approximates to a condition of saturation, in which the particles lie preferably with their long direction parallel to the direction of flow. Brownian movement diminishes the orientation and, when it preponderates, the direction of orientation is at 45° to the direction of flow. The flow produces tensions and pressures at 45° to the flow and non-rigid particles are deformed to an extent and direction dependent on the elasticity of form and the viscosity of the particles. Both orientation and deformation are related to the appearance of accidental double refraction, for which special regularities hold. Typical rod sols like V_2O_5 behave quite in accordance with the theory on the orientation of anisodimensional particles. Lyophile colloids (myosin solutions), however, show the laws of the deformation effect, and their particles are thus to be regarded as soft, readily deformable clots. T. H. P.

12. Variability of the Electrokinetic Jump in Potential. G. Ettisch and A. Zwanzig. *Zeits. f. phys. Chem.* 160. *Abt.A.* 6. *pp.* 385–408, *July*, 1932.—The determination of the electrokinetic potential gradients is obtained by the application of the method of streaming potentials and it is shown that the electrokinetic potential is dependent on the pressure. This is true not only for water-alcohol mixtures containing electrolytes but also for pure aqueous electrolyte solutions. The effect has heretofore been missed because low-pressure determinations have not been carried out. The meaning of this phenomenon is explained and several important deductions made. [See Abstract 3299 (1930).] J. K.

13. Electrokinetic Phenomena. H. A. Abramson. *J. Phys. Chem.* 36. *pp.* 2141–2144, *Aug.*, 1932.—It is shown that certain data on the effects of salts on the surface conduction of cellulose [see Abstract 2114 (1931)] are not inconsistent with the combined theories of Smoluchowski and Debye and Hückel, but that the data indicate the incomplete form of the classical theory. H. H. Ho.

14. Fundamental Assumptions and Equations of Electrokinetics. J. W. MacBain and M. E. Laing-MacBain. *Zeits. f. phys. Chem.* 161. *Abt.A.* 4–5. *pp.* 279–298, *Sept.*, 1932.—The older classical theory of electrokinetics is shown to be invalid and new relationships are derived by means of the Laing-MacBain theory which afford a satisfactory explanation of the phenomena. H. H. Ho.

15. Technical Applications of Electroosmosis and Electrophoresis. N. Schönfeldt. *Zeits. f. Elektrochem.* 38. *pp.* 744–754, *Sept.*, 1932.—A brief account is given of the applications of these phenomena to: drying of peat; purification of water; coagulation of rubber; refining of sugar; separation of clay and kaolin; purification of glycerin, glue and gelatin; tanning, impregnation and preservation; purification of serum; preservation of green fodder; gas purification; separation of oil-water emulsions; diaphragm- and electrode-materials. A full list of literature and patent references is added. T. H. P.

16. Isoelectric Point of Silk. M. Harris. *Bureau of Standards, J. of Research*, 9. *pp.* 557–560, *Oct.*, 1932.—For these measurements, use has been made of (1) suspensions of silk in buffer solutions of different pH values, prepared by grinding dry silk fibroin to a fine powder and shaking this in the buffer solution, and (2) colloid silk solutions made by dissolving the silk fibroin in 50 % LiBr solution and dialysing to remove the salt. Known buffer mixtures and a small amount of purified quartz powder were added to the solutions. Electrophoretic measurements of the suspensions of silk and of the dissolved silk adsorbed on the quartz particles gave an isoelectric point at pH 2·5. This low value shows silk to be one of the most acidic proteins, this being in accordance with some of its properties, such as its pronounced affinity for basic dyestuffs. The shape of the pH mobility curve shows that the acidic and basic properties are less pronounced than those of wool. T. H. P.

17. Lyotropic Numbers and Properties of Ions. E. H. Büchner, A. Voet and E. M. Bruins. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 563–569, 1932. *In German.*—The lyotropic number T bears a linear relationship to F, the period at which the number of particles per unit volume *n* is the same for gold sols undergoing coagulation by various alkali halides. From the hyperbolic relation between *n* and time it follows that for a constant salt concentration the time necessary for reduction of the sol concentration to a given fraction of its initial value and also the coagulation value, defined as the concentration of electrolyte necessary to reduce the sol concentration to a predetermined value, are linear functions of T. The same is true of the decrease of the electrokinetic potential caused by addition of an electrolyte to a sol, of the influence of neutral salts on the rate of inversion of sucrose, of the influence of anions on the velocity of saponification of esters, and of the ionisation potentials of alkali metals and the lattice energies of the alkali halides. H. F. G.

18. Lyotropic Numbers and Viscosity. E. H. Büchner, E. M. Bruins and J. H. C. Merckel. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 569–575, 1932. *In German.*—The curves relating the lyotropic number T and the viscosity η of 0·25–1·0 *N* solutions of monobasic acids are linear and all intersect the T axis ($\eta = 1\cdot0$) at $T = 12\cdot5$. A similar relationship obtains in the case of potassium and sodium salts, and of gelatin and starch sols at moderate electrolyte concentrations. H. F. G.

19. Tension Double Refraction of Colloids in Solution. W. Kuhn. *Zeits. f. phys. Chem.* 161. *Abt.A.* 6. *pp.* 427–440, *Oct.*, 1932.—The flow double refraction of suspensions of elongated particles is calculated on the assumption that every particle is at first optically isotropic and that it becomes doubly refracting under the action of forces of tension and compression. For solutions of rubber, polystyrene and gelatin, it is shown that the flow double refractions thus calculated agree with observed values, and that the relation between length and thickness of the particles deduced from this double refraction agrees with that derived from viscosity measurements. An approximate formula for the viscosity is employed, η for elongated particles being proportional to the square of the length of the particle. The assumptions made in arriving at this formula—small particles, marked Brownian movement—are shown to be justified, whereas Eisenschitz's formula [see Abstract 1814 (1932)] is valid only if Brownian movement is entirely absent. T. H. P.

20. Determination of the Magnitude, Shape and Solvation of Macro-Molecules. G. V. Schulz. *Zeits. f. phys. Chem.* 161. *Abt.A.* 6. *pp.* 441–462, *Oct.*, 1932.—The osmotic pressure P_0 of a colloidal solution may be expressed by the formula (1) $P_0(1 - cs) = cRT/M$, where s is the specific solvation volume (volume required by 1 gm. of the solute plus the combined solvent), c the concentration and M the molecular weight of the solute [see Abstract 2622 (1932)]; this allows of the determination of M and s. Eisenschitz's equation for the specific viscosity, (2) $\eta_{sp} = 0\cdot159csl/d \,.\, \log \frac{2l}{d}$ [see Abstract 1814 (1932)], contains two unknown variables, s and the axial ratio $l : d$. Assuming that the same solvation volume is given by the viscosity as by the osmotic pressure, s in (2) may be determined by an osmotic measurement, so that $l : d$ is calculable. Study of the case of fresh rubber solutions shows that the osmotic and viscosimetric solvation volumes agree and that such solutions contain elongated thread-like molecules. These molecules are highly solvated, a benzene solution of rubber containing particles 7550 Å. long and $61\cdot5$ Å. wide, with a solvate layer 25 to 30 Å. thick. The ageing of rubber solutions comprises three groups of reactions: cracking of the larger molecules; chemical changes, shown in alternations of the degree of solvation; parallel superposition of the cleavage fragments to bundles (5 to 10) of principal valency chains. A gelatin solution was found to contain particles 926 Å. long, composed of 2 to 3 principal valency chains. T. H. P.

21. Periodic Precipitation of Silver Salts. Suzanne Veil. *Comptes Rendus*, 195. *pp.* 606–608, *Oct.* 10, 1932.—The Liesegang rings formed when a drop of an aqueous solution of silver nitrate is placed on gelatin impregnated with potassium chromate, phosphate or arsenate, are similar *inter se*, and show secondary microscopic stratification; this last is not shown in the rings formed by the reverse method, *i.e.*, by placing a drop of the potassium salt on gelatin impregnated with silver nitrate. C. A. S.

22. Liquid Sodium Amalgams. G. R. Paranjpe and R. M. Joshi. *J. Phys. Chem.* 36. *pp.* 2474–2482, *Sept.*, 1932.—The data available on liquid sodium amalgams are considered from the colloid point of view, and it is attempted to show that the colloid hypotheses explain all those results satisfactorily. It is concluded that liquid sodium amalgams are hydrargyrophilic colloidal solutions of sodium in mercury with $(Na_x)Hg_y$ as the colloid micellæ, that the mere statement of the concentration of an amalgam is not sufficient to define it, but that the method of preparation, the age and the previous history must also be stated with it. J. K.

23. Mercury Emulsions Prepared by Means of Ultrasonic Waves. H. B. Bull and K. Söllner. *Kolloid Zeits.* 60. *pp.* 263–268, *Sept.*, 1932.—Mercury is emulsified in water and aqueous solutions by means of ultrasonic waves. The emulsions prepared were relatively crude as the radius of the particles is on the average 0·5 to 1·0 μ. The emulsification is in general strongly promoted by the presence of ions having high valencies and which are readily adsorbable. The purest distilled mercury gives in pure water electropositive particles. J. K.

24. Calculation of the Molecular Weight of a Polar Colloid from Dielectric Dispersion Curves of its Aqueous Solution. B. M. Bloch and J. Errera. *Phys. Zeits.* 33. *pp.* 767–769, *Oct.* 15, 1932.—A mathematical paper not lending itself to abstraction. [See Abstract 3033 (1932).] J. K.

25. Distribution of Suspended Particles Under Gravity. C. M. McDowell and F. L. Usher. *Roy. Soc., Proc.* 138. *pp.* 133–146, *Oct.* 1, 1932.—Recent experimental work is criticised on the grounds of inadequate temperature control and of failure to attain equilibrium conditions. Measurements of the distribution of the particles in a gold sol throughout a depth of 1 cm., at a temperature varying by not more than 0·001° C. per hour, show that Perrin's law is valid for distances up to 0·9 cm. from the surface and for concentrations up to 10^{12} particles per c.c. H. F. G.

See also Abstracts 40, 47, 121, 350, 351.

CRYSTAL STRUCTURE AND PROPERTIES.

26. Separation of the α-Phase in β-Brass. M. Straumanis and J. Weerts. *Zeits. f. Physik*, 78. 1–2. *pp.* 1–17, *Sept.* 8, 1932.—The separation of the cubic face-centred α-phase from the copper-rich, body-centred β-phase of copper-zinc alloys has been studied from X-ray and microphotographs of single crystals. The α-crystallites are oriented to the lattice of the β-crystal (independently of the nature of the heat treatment) regularly in 24 positions. The building of the α-phase lattice from that of the β-phase can be described as a sequence of slippings and is in the crystallographic sense reversible. These processes are a reversal of those described by Kurdjumow and Sachs for the lattice change cubic face-centred to body-centred in the change austenite → martensite. Specimens of β-crystals, after quenching and annealing, give lamella or rod-shaped crystallites of the α-phase accordingly as the annealing is carried out at low or high temperatures. F. J. W.

27. X-Ray Study of the Electrolytic Fe-Ni Alloys. K. Iwasé and N. Nasu. *Chem. Soc. Japan, Bull.* 7. *pp.* 305–314, *Sept.*, 1932.—Iron and nickel were deposited together from an acid solution of their mixed sulphates and the diffraction patterns measured of the alloys so obtained. The α and γ solid solutions were always observed, and neither pure iron nor nickel could be found. The heterogeneous region of α and γ was enormously wide compared with the alloy formed from the melt. The lattice constant-concentration curves have a maximum for both the α and the γ solid solutions. F. J. W.

28. Physical Properties and Structure of the Binary System Iron-Cobalt. A. Kussmann, B. Scharnow and A. Schulze. *Zeits. f. techn. Physik*, 13. 10. *pp.* 449–460, 1932.—As a systematic test of the constitution of the α-mixed crystal region in the system Fe-Co, the electrical conductivity, magnetic quality, Curie points, specific gravity, thermal expansion and mechanical hardness of a series of alloys of these metals were measured. It is confirmed that in the curve of electrical (and thermal) conductivity, the value increases between 30 % and 70 % Co to a pronounced maximum at about 50 %. In approximately the same region there is a similar increase in the saturation intensity of magnetisation. The conductivity maximum at 50 % Co diminishes as the temperature rises, and almost disappears at 800° C. It is suggested that the explanation of the anomalies must be either a magnetic one or one of structure. From the latter point of view it is regarded as probable that an orderly distribution of atoms in the form FeCo takes place in the region referred to, and that FeCo is the carrier of high conductivity and high permeability, and that this arrangement changes to one of mixed crystals with rise of temperature. G. E. A.

29. Incidence of Lattice Distortion and Orientation in Cold-Rolled Metals. W. A. Wood. *Phil. Mag.* 14. *pp.* 656–665, *Oct.*, 1932.—The rate of production of lattice-distortion and preferred orientation during the cold-rolling of certain metals and alloys has been determined by X-ray methods. It was found: (1) That the degree of distortion plotted against the percentage reduction of thickness gives a definite type of curve, which is marked by an initial rapid rise of distortion to a constant value which further reduction maintains; this steady value is characteristic of the metal. (2) The preferred orientation does not occur gradually from commencement of working; it appears after about 35 to 50 % reduction, according to the metal, and then grows rapidly. (3) Lattice-distortion, when it occurs, reaches its maximum value before preferred orientation appears; it is shown that the latter cannot play a primary part in the changes of properties produced by cold-working. AUTHOR.

30. Atomic Arrangement in Glass. W. H. Zachariasen. *Am. Chem. Soc., J.* 54. *pp.* 3841–3851, *Oct.*, 1932.—The characteristic properties of glasses are explicable if the interatomic forces in a glass are essentially the same as in a crystal. The main difference between the three-dimensional network in a crystal and that in a glass lies in the presence of symmetry and periodicity in the former and their absence in the latter. The conditions under which a glass network with an energy content comparable with that of the corresponding crystal can be formed are determined for oxide glasses, only certain oxides occurring in vitreous forms. Oxide glasses must contain one or more of certain types of kation, and the optimum chemical composition is deduced. The results are in complete agreement with empirical facts. C. B. A.

31. Structure of Potassium Osmiamate. F. M. Jaeger and J. E. Zanstra. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 610–624, 1932.—This compound, $KOsNO_3$, forms tetragonal-bipyramidal crystals, $a : c = 1 : 2{\cdot}3123$, but its symmetry differs but little from the ditetra-

V. 19

gonal-bipyramidal. The crystals are hemihedral of the class C_{4H}^{6}. The unit cell contains $K_4Os_4N_4O_{12}$, and the true specific gravity of the crystals at 0° is 4·616. The parameters are calculated. The nitrogen and oxygen atoms are arranged round the very small central osmium ions in such a way that they are situated in the corners of a tetragonal bisphenoid which is very near to a regular tetrahedron compressed somewhat in the direction of the *c*-axis. T. H. P.

32. Structure of Cæsium Osmiamate. F. M. Jaeger and J. E. Zanstra. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 779–786, 1932.—The crystals of this salt are rhombic-bisphenoidal and pseudo-tetragonal. Their orientation with respect to the other pseudo-tetragonal salts is, however, such that their *a*- and *b*-axes have the directions of the zone-axes [110] and [1$\bar{1}$0] in the crystals of the potassium salt. Moreover, their spacings in these directions are completely comparable with those of the other osmiamates parallel to [110] and [1$\bar{1}$0]. The angular values are not constant, but vary between rather wide limits. The axial ratios appear to be $a : b : c = 0{\cdot}9759 : 1 : 1{\cdot}7157$, but rotation spectrograms prepared by turning the crystals round the *a*, *b* and *c* axes respectively give the axial ratios 8·08 : 8·35 : 7·22 or 0·9676 : 1 : 0·8648. Hence the values given by crystallographic measurements must be taken as 0·9759 : 1 : 0·8577. The space group is V^2. The mutual relations between the tetragonal potassium salt and the rhombic but truly pseudo-tetragonal ammonium, rubidium, thallium and cæsium salts are fully explained by the crystalline structures deduced for these salts. [See preceding Abstract and following Abstract.] T. H. P.

33. Structure of Ammonium, Rubidium and Thallium Osmiamates. F. M. Jaeger and J. E. Zanstra. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 787–798, 1932.—These salts are closely analogous to the corresponding potassium compound [see Abstract 31 (1933)], as they are of truly pseudo-tetragonal character, but they deviate by their lower symmetry, which is rhombic-bisphenoidal. For the ammonium salt, $a : b : c = 0{\cdot}9437 : 1 : 2{\cdot}3106$, for the rubidium, 0·9539 : 1 : 2·3356, and for the thallium, 0·9542 : 1 : 2·3679. The rotation spectrograms of the rubidium salt and the powder spectrograms of the ammonium and rubidium salts are described. T. H. P.

34. Structure of Tetra- and Tri-Phosphonitrile Chlorides. F. M. Jaeger and J. Beintema. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 756–762, 1932.—Tetraphosphonitrile chloride forms tetragonal-bipyramidal crystals, $a : c = 1 : 1{\cdot}5492 - 1{\cdot}5508$, apparently holohedral, but the hemihedral symmetry is clearly proved by a Laue-pattern. The unit cell has $a_0 = 10{\cdot}79$ and $c_0 = 5{\cdot}93$ Å. and contains $P_8N_8Cl_{16}$; the space group is C_{4h}^{4}. Triphosphonitrile chloride forms rhombic-bipyramidal crystals, $a : b : c = 0{\cdot}9238 : 1 : 0{\cdot}4397$; the unit cell contains $P_{12}N_{12}Cl_{24}$ and is a simple rhombic one, the space group being V_H^{16}. T. H. P.

35. Crystal Structure of Green Salt of Magnus, and Related Compounds. E. G. Cox, F. W. Pinkard, W. Wardlow and G. H. Preston. *Chem. Soc., J. pp.* 2527–2535, *Oct.*, 1932.—The conditions for the formation of the green and pink salts of Magnus have been investigated. X-ray determination of the crystal structure shows that the former is not a polymerised substance; the ions $[PtCl_4]$ and $[Pt, 4NH_3]$

have the same form as in K_2PtCl_4 and $[Pt, 4NH_3]Cl_2$, except that the ammonia groups in the kation are not rotating. An orthorhombic pink salt of Magnus has been found to exist, but the pink salt commonly obtained is actually Cleve's salt $[Pt, 3NH_3, Cl]_2[PtCl_4]$. Both the true pink salt of Magnus and Cleve's salt are convertible into the green salt.

T. H. P.

36. Crystal Structure of α-Methylxyloside. E. G. Cox. *Chem. Soc., J. pp.* 2535–2543, *Oct.*, 1932.—It was shown previously [see Abstract 1839 (1932)] that a close relation exists between the crystal lattices of β-methylxyloside and α-xylose, and it is now found that there is a similar and even closer relation between the lattices of α-methylxyloside and α-xylose. The molecular arrangement in crystalline α-methylxyloside has been determined with some degree of certainty and further progress has been made towards the exact determination of the form of the pyranose sugar-ring. Arguments against completely planar or *trans*-strainless forms of this ring are advanced. The goniometric axial ratios for β-methylxyloside were given (*loc. cit.*) erroneously as $a : b : c = 1{\cdot}040 : 1 : 1{\cdot}022$; these values should have been $1{\cdot}134 : 1 : 1{\cdot}115$, which agree well with X-ray results. T. H. P.

37. Crystal Structure of Polymorphic Forms of Saturated Mono- and Di-Carboxylic Acids. F. D. la Tour. *Ann. de Physique*, 18. *pp.* 199–284, *Oct.*, 1932.—A detailed account with some additions and corrections (tabulated below) of work already published [see Abstract 3699 (1931)]. Mono-carboxylic acids: α-palmitic acid has *a*, 9·41; *b*, 5·00; *c*, 45·9 Å.; β, 50° 50′; with 4 molecules in the unit cell, n_α, 1·533; n_β, 1·506; β-stearic acid has *a*, 5·68; *b*, 7·39; *c*, 50·7 Å.; β, 60°; with 4 molecules in the unit cell, n_α, 1·535; n_γ, 1·508. Di-carboxylic acids:—

Acid	Crystal system	Transition Temperature, $\alpha \rightarrow \beta$*	Unit cell					Crystal Group
			a	*b*	*c*	β	No. of Mols.	
Malonic-α	rhombic	80°	8·70	11·53	17·05	90°	16	—
Malonic-β	triclinic		—	—	—	—	2	—
Succinic-α	monoclinic	137°	5·70	26·2	7·57	115° 45′	8	C_{2h}^{3}
Succinic-β	monoclinic		5·06	8·81	7·57	133° 37′	2	C_{2h}^{2}
Glutaric-α	monoclinic	74°	10·34	5·08	32·9	129°	8	C_{2h}^{6}
Glutaric-β	monoclinic		10·06	4·87	17·4	132° 35′	4	C_{2h}^{6}

* The reverse transition is effected only by fusion and cooling.

C. A. S.

38. Crystal Axes of Single-Crystal Wires. B. Chalmers. *Phil. Mag.* 14. *pp.* 612–616, *Oct.*, 1932.—A geometrical method for interpreting the data of microscopical observation of the surface-markings on a crystal wire (*e.g.*, cadmium) when stretched. A. D.

39. Modified Ionic States in Crystals. C. P. Snow and F. I. G. Rawlins. *Cambridge Phil. Soc., Proc.* 28. *pp.* 522–530, *Oct.* 31, 1932.—Types of bands in absorption spectra of the compounds of transitional elements (especially Cr) are considered in detail. Broad regions of absorption are shown to be of a molecular origin, while narrow bands, when they occur, can be ascribed to an ionic or quasi-ionic origin, corresponding to inter-combination transitions such as ${}^4F$–${}^2G$. Theoretical intensity conditions are in agreement with these views, and the rare earths are capable of treatment in the same way. Examples are the strong lines well known in compounds of Pr and Nd, and the much weaker lines characteristic of Sa and Eu. F. I. G. R.

40. Influence of Foreign Substances on the Cohesion Limits and Ultramicroscopic Sol-Formation of Synthetic Rock-Salt Crystals. Part III. Heavy Metal Chlorides. W. Metag. Part IV. Density Determinations. J. Köhler. *Zeits. f. Physik,* 78. 5–6. *pp.* 363–374 and 375–382, *Oct.* 4, 1932.—The influence of foreign additions has been studied previously only with chlorides of potassium and alkaline earth metals [see Abstract 3127 (1932)]. The effects produced by small proportions of CuCl, AgCl, TlCl and $PbCl_2$ on the cohesion limits and on the ultra-micron number of the synthetic rock-salt crystals have now been investigated. The results confirm the previous finding, namely, that the increases in strength are connected with a microscopic and probably molecular-disperse structure, and that the influence of an added divalent kation is considerably greater than that of a univalent kation. The densities at 15° C. of pure crystals from the molten salts are found to be: NaCl, $2{\cdot}1653 \pm 0{\cdot}0002$; KCl, $1{\cdot}9901 \pm 0{\cdot}00015$; KBr, $2{\cdot}7460 \pm 0{\cdot}00015$. In these crystals no variation in density is detectable, but a mixed NaCl-AgCl crystal shows appreciable density variations both perpendicular and parallel to the direction of the pull during the growth from the fused mass. T. H. P.

41. X-Ray Diffraction Method for Crystalline Aggregates. H. Seeman. *Phys. Zeits.* 33. *pp.* 755–763, *Oct.* 15, 1932.—A method of taking X-ray diffraction photographs is described in which the reflected beam as well as the incident one passes through a diaphragm. The method is used for taking photographs of materials possessing a fibre structure, the principle being that, owing to the second diaphragm, only those planes bearing a definite geometrical relationship to the specimen will be able to produce a reflection on the photographic plate. Three variations of the method are described. In the first, a flat specimen is placed between the diaphragms. In the second, a tubular specimen is inserted, and in the third, a flat specimen is again employed, but both diaphragms are on the same side of the specimen. J. T.

See also Abstracts 54, 55, 56, 64, 99, 208, 258, 345, 389, 395.

DENSITY.

42. Density Curves and Rectilinear Diameter of Carbon Monoxide. E. Mathias, C. A. Crommelin, W. J. Bijleveld and P. P. Grigg. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 551–553, 1932. *In French. Communication No.* 221*b from the K. Onnes Lab., Leiden.*—Densities of the liquid and saturated vapour are tabulated from the critical point [see Abstract 1671 (1932)] to 68°·12 Abs. for 18 temperatures. The diameter from observation is compared with the formula $y = 0{\cdot}03290 - 0{\cdot}0019120\theta$; the deviations are of order 1 %, greater than for H and Ne, but similar to N and C_2H_4, and have the systematic character of A and C_2H_4. The critical density found is 0·3010. T. L. M.

43. Alkali Metals and Salt Densities in Liquid Ammonia. W. C. Johnson and A. W. Meyer. *Am. Chem. Soc., J.* 54. *pp.* 3621–3628, *Sept.*, 1932.—Reference is made to the work of Kraus and co-workers. It has been previously shown that the process of solution of sodium or potassium in liquid ammonia is accompanied by a substantial increase in volume. In view of the interesting properties of these solutions, measurements are given for the density of solutions of potassium in liquid ammonia at different concentrations. In addition, the density of saturated and also highly diluted solutions of sodium is determined as a verification of the method employed. To contrast the behaviour of these metal solutions with solutions of salts in liquid ammonia, similar measurements are given for sodium bromide solutions. J. K.

See also Abstracts 28, 31, 40, 275.

DIFFUSION AND OSMOSIS.

44. Theory of Diffusion. B. Bružs. *Zeits. f. phys. Chem.* 162. *Abt.A.* 1–2. *pp.* 31–43, *Oct.*, 1932.—The van't Hoff concept of osmotic pressure is extended to binary liquid solutions of any concentration, and a thermodynamic equation for the variation of osmotic pressure with concentration is developed. Equations are given for the diffusion coefficient, for the law of diffusion of the solvent and solute, and for the Hittorf coefficients, and a general diffusion or penetration law is developed. The Soret coefficient is calculated from the Soret effect. The paper is almost entirely mathematical. H. F. G.

45. Diffusion of Alcohols. G. Franke. *Ann. d. Physik,* 14. 6. *pp.* 675–682, *Aug.* 30, 1932.—Reference is made to the work of Münter, Lamm and Gerlach. The present paper investigates further the conclusions of Münter, who showed that the diffusion coefficient is dependent on the concentration. J. K.

46. Absorption from a Streaming Gas. H. v. Wartenberg and M. Brzezinski. *Zeits. f. techn. Physik,* 13. 10. *pp.* 501–504, 1932.—The authors investigate whether the amount of gas carried in a stream of another gas and absorbed by a wall can be calculated. They find that it can be calculated from the radius of the tube conveying the stream, the velocity of the stream and the diffusion constant of the gas. They confirm their formula by experiments with iodine carried in a stream of hydrogen or air and absorbed by KI paper. To render the stream laminar it is first conducted through a set of narrow parallel glass tubes. E. E. F. d'A.

47. Absorption and Classical Diffusion. A. T. McKay. *Faraday Soc., Trans.* 28. *pp.* 721–731, *Sept.*, 1932.—The solutions of the diffusion equation are considered for boundary conditions appropriate to experimental problems. The results are applied to the consideration of the absorption of water by fibre boards and waxed upper leather, together with the diffusion of sucrose in gelatin gels and the swelling of Laminaria leaf. F. J. W.

48. Diffusion of Gases through Fused Quartz. Liu Sheng T'sai and T. R. Hogness. *J. Phys. Chem.* 36. *pp.* 2595–2600, *Oct.*, 1932.—Villard in 1900 found that fused quartz at a high temperature was permeable to hydrogen. Other observers have proved the diffusion of hydrogen, helium, neon, argon, oxygen and nitrogen through fused silica and glass. The present authors undertake quantitative experiments on the diffusion of various gases through the walls of a diffusion cell consisting of a thin tube (0·033 cm.) of clear fused quartz at different temperatures. Measurable results are obtained for neon and helium, and these are given in tables and curves. No definite diffusions are observed for nitrogen, oxygen and argon, though in the case of argon spectroscopic tests show that diffusion of this gas takes place at the highest temperatures. The results indicate that the quartz glass must be regarded as possessing channels which increase in clearance with increasing temperature. T. B.

49. Diffusion of Helium through Glass. W. D. Urry. *Am. Chem. Soc., J.* 54. *pp.* 3887–3901, *Oct.*, 1932.—A method of determining accurately the rate of diffusion of He, Ne and H_2 through glass at comparatively low temperatures and pressures is outlined and the results are given for pyrex glass, lead glass, soda glass and Jena 16-in. glass. The results are discussed in the light of previous experiments on the helium content of glasses, outgassing effects and the "clean-up effect." It is concluded that in the process of diffusion through glass, helium and hydrogen are first absorbed on the glass surface and solubility and diffusion proceeds from this adsorbed or absorbed (in the case of hydrogen) layer. This theory may be extended to other gases equally well. E. E. F. d'A.

50. Osmotic Pressure and the Permeability of Membranes. W. W. Lepeschkin. *J. Phys. Chem.* 36. *pp.* 2625–2638, *Oct.*, 1932.—The abnormally low hydrostatic pressure, *viz.*, 30 times smaller than the theoretical osmotic pressure, observed with osmometers using a parchment paper membrane is not caused by accumulation of solute under the membrane. It is shown that the force with which water is sucked into an osmometer, which depends on the permeability to the solute, is given by $P(1 - \mu)$, where P is the osmotic pressure and μ a factor proportional to the permeability. The maximum hydrostatic pressure $P_m = P(1 - \mu)(1 - \mu/\sigma)$, where σ is a factor proportional to the permeability of the membrane to water. For one kind of parchment paper and NaCl solution $\mu = 0{\cdot}67$ and $\sigma = 0{\cdot}71$; after use for filtration of water and NaCl solutions for 3 months, $\mu = 0{\cdot}83$ and $\sigma = 1{\cdot}02$. For copper ferrocyanide membranes σ is very great compared with μ, and P_m then becomes approximately equal to $P(1 - \mu)$. H. F. G.

See also Abstract 20.

ELASTICITY AND PLASTICITY.

51. Elastic Displacements of Plane Systems. A. Giannelli. *Accad. d'Italia, Mem.* 3. 2. *pp.* 5–54, 1932.—Considers the displacements generated in a definite section of a plane elastic system by forces applied in another section, establishes certain correlations in the section and defines the "conics of longitudinal or transverse elasticity." Points out the geometrical and mechanical properties of the homographic relations existing between the centres and axes of rotation of one of the two sections relative to normal and transverse forces applied to the other.

E. E. F. d'A.

52. Compressibility of Liquid Helium at 2·7° K. W. H. Keesom and K. Clusius. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 320–332, 1932. *In German. Comm. No.* 219f *from the K. Onnes Lab., Leiden.*—The compressibility of liquid helium at 2·71° K. and at pressures from 5 to 10 kg./cm.^{2} considerably exceeds those hitherto found for other liquids. The value of the compressibility extrapolated to small pressures agrees

satisfactorily with the values calculated from the expansion coefficient and the difference between the specific heats at constant pressure and at constant volume as previously determined [see Abstract 276 (1932)].
L. G. C.

53. Elasticity of Rubber. H. Staudinger. *Kolloid Zeits.* 60. *pp.* 296–298, *Sept.*, 1932.—It is shown that the elastic properties of rubber are not, as previously supposed, dependent on the presence of a double bond as hydrocaoutchouc and other highly polymerised substances also show elastic properties, though it is true only between certain temperature limits. Relationships are shown to exist between the length of the molecules and the elasticity of these highly polymerised substances. Quantitative determinations so far have not been made. J. K.

54. Plastic Extension of α-Iron Crystals. W. Fahrenhorst and E. Schmid. *Zeits. f. Physik*, 78. 5–6. *pp.* 383–394, *Oct.* 4, 1932.—Previous investigation of the deformation of Fe crystals has led to a difference of opinion as to the mechanism of the slip occurring. The present experiments show that at room-temperatures the most probable mechanism is a true crystallographic translation in the direction (111). At −185° C., where slip is very small, the results show definite twinning. J. P. A.

55. X-Ray Study of the Plastic Working of Magnesium Alloys. L. G. Morell and J. D. Hanawalt. *Physics*, 3. *pp.* 161–168, *Oct.*, 1932. —The inner structure of Dowmetal fabricated by various processes, such as forging, rolling, extruding and drawing, has been studied by means of X-ray diffraction. The X-ray diffraction patterns are identified by comparing them with computed fibre patterns for the close-packed hexagonal system, $c/a = 1 \cdot 62$. Three distinct structures are obtained —a [210] fibre structure at ordinary temperatures and a [110] fibre structure at temperatures higher than about 450° C. with the fibre axis, in both cases, in the direction of extrusion or drawing, and a [001] fibre structure with the fibre axis in the direction of forging. The difference in the structure of metal extruded at low and high temperatures is discussed in terms of the glide systems of magnesium. AUTHORS.

56. Time of Relaxation of Heated Copper and Aluminium Wires in Torsional Vibration. D. Schenk. *Zeits. f. Physik*, 78. 7–8. *pp.* 470–478, *Oct.* 12, 1932.—Using a method given by Kortum the amplitude of the torsional vibrations was measured for drawn Cu and Al wires and the time of relaxation (1/R) was determined. By heat treatment the structure of the wire is altered, and results are shown for Cu when heated to various temperatures between 150° and 1000° C. The crystalline structure of Cu is quite lost by heating to 170° C., but at higher temperatures recrystallisation begins in a regular way. The oscillatory motion can be analysed into (1) a motion of the individual crystals, and (2) a motion of the crystals against one another. The relation for R depends on the oscillation produced. The changes do not occur simultaneously in all parts of the wire. From the observed results, conclusions can be drawn regarding the change of crystalline structure which has occurred with heat treatment. For Al wires the changes are less clearly marked and less regular than for Cu wires. R. S. R.

57. Theory of a Resonance Vibration Absorber. O. Föppl. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 257–260, *Oct.*, 1932.—The

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dynamical equations are formulated for a vibration absorber in which the vibrations of a machine are transmitted to a tuned oscillating mass moving against a frictional force. From the solutions of the equations information as to the best relative dimensions for such a damper is derived. J. P. A.

58. Theory of a Vibration Absorber. G. Bock. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 261–274, *Oct.*, 1932.—A vibration absorber is considered in which the forced torsional oscillations of a rod are damped by internal friction in the material. This system and that formed by adding the absorber to another vibrating system are analysed mathematically. J. P. A.

59. End Pressures on a Damped Oscillating Bar. K. Sezawa. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 275–279, *Oct.*, 1932.—A bar of a material having internal friction executes transverse oscillations while under the action of thrusts at the ends. The problem is stated mathematically and solved. The end pressures have a profound effect on the frequency of oscillation, in extreme cases reducing it to zero, and, under conditions here determined, sometimes producing a labile state in the bar. J. P. A.

60. Vibrations of One-Storied Framed Structures. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 767–803, *Sept.*, 1932. *In English.*—A horizontal beam, supported on a specified number of equidistant identical pillars constitutes a one-storied framed structure. The following problems, relating to this structure are dealt with: (1) The natural periods of a structure with an infinite number of spans, (2) forced vibrations of the same structure as produced by seismic oscillations, (3) the natural periods of a structure of two spans, and (4) the forced vibration of a structure of two spans. The general solutions are difficult to obtain, but the detailed character of the results is sufficiently outlined by a complete calculation of a number of numerical examples. In problem (2), when resonance occurs, the greatest amplitudes occur at the tops of the pillars. For higher frequencies the greatest amplitude is nearer the ground, while for low frequencies the forms taken by the beam and pillar are very similar to those deduced from the theory of static bending. The general character of the results for two spans is practically that of the structure with an infinite number; addition of spans after the second does not alter the results appreciably. Calculations and diagrams are given in great detail. J. P. A.

61. Theory of the Frahm Vibration Recorder. W. Meyer zur Capellen. *Ann. d. Physik*, 15. 1. *pp.* 1–27, *Oct.*, 1932.—The Frahm vibration recorder is a thin rod with a heavy weight at one end and suspended delicately and freely at the other so that if the point of suspension is acted upon by a periodic force such that the frequency corresponds to the natural period of the rod, then the whole pendulum arrangement vibrates with the characteristic frequency of the exciting forces. The present paper is a mathematical and theoretical study of the conditions governing the structure and action of such an arrangement and gives a complete set of equations for this purpose. S. G. B.

62. Bursting Strength of Glass Tubes. H. v. Wartenberg. *Zeits. f. techn. Physik*, 13. 10. *pp.* 479–481, 1932.—Four different glasses of German manufacture are tested over a range of temperatures by means of hydrostatic pressure applied to the inside of tubes made therefrom. The tubes may be subjected with safety, up to temperatures near the transformation points, to pressures which are just safe at room-temperatures. The strength does not appear to decrease to any important extent over this range of temperature. The values of the bursting strengths for various tubes, and their variations with radius and thickness of wall, are determined. J. P. A.

63. Central Deflection of a Square Plate with Clamped Edges Subject to a Uniform Pressure over one Face. K. R. Gunjikar and V. D. Majmudar. *Phil. Mag.* 14. *pp.* 565–570, *Oct.*, 1932.—The deflection at the centre of a plate under the stress system specified in the title is found experimentally to agree with the theoretical value. J. H. A.

64. Reticular Distortion and Internal Stresses of Metals. V. Montoro. *Accad. d'Italia, Mem.* 3. 2. (*Fisica*). [20 *pp.*], 1932.—The distortions of the space lattices of cast-iron and steel were investigated by the spectroscopic method of Debye. From the variations in the reticular distance found in the directions [211] and [220] is deduced a dilatation of 3·8 %, assuming the deformation to be in the form of an ellipsoid. The corresponding internal stress is 78 kg./mm.^{2} E. E. F. d'A.

65. Calibration of a Pressure Balance in Absolute Units. A Michels. *K. Akad. Amsterdam, Proc.* 35. 7. *pp.* 994–1003, 1932.—Measurements were carried out in a tower with laboratories at heights of 10, 24 and 38 m. and connected by a vertical wooden case. The mercury is in a steel tube and its height is measured with an invar tape and cathetometers, while its mean temperature is obtained from thermometers passing through the wall of the case or by a resistance thermometer. The calibration of the invar tape and the measurements made in the calibration of a pressure balance are described. R. S. R.

66. Measurement of Manometric Differences in Level. H. Klumb and T. Haase. *Zeits. f. techn. Physik*, 13. 8. *pp.* 372–373, 1932. —Two fine tungsten wires run axially in the limbs of a U-tube manometer, part of each being immersed in and part above the mercury. The wires are suitably connected in a resistance bridge, the ratio of their resistances being a simple function of the pressure difference between the two limbs. With ordinary pressures operating, differences of 0·05 mm. Hg may be determined; when the pressures are of the order 1·0 mm. Hg, observations are uncertain owing to heat conductivity of the gas; below 1 mm. and down to 10^{-5} mm. Hg, the system operates as a radiation manometer of the Pirani type. It could be adapted to temperature measurement, by filling one limb with a suitable gas or liquid. L. V. C.

See also Abstracts 10, 185, 409.

GRAVITATION.

67. Gravitational Field of a Homogeneous Sphere. J. Ghosh. *Indian Phys. Math. J.* 3. *pp.* 139–142, *Sept.*, 1932.—Works out a solution of the problem of the homogeneous sphere, both for external and internal field, more general than that of Schwarzschild, on the assumption that the density is constant, and that the radial and transverse stresses are linearly related. A. D.

See also Abstract 151.

HYDRODYNAMICS AND AERODYNAMICS.

68. Aerodynamical Equation Solved Experimentally. J. Pérès and L. Malavard. *Comptes Rendus,* 195. *pp.* 599–601, *Oct.* 10, 1932.—The electrical experimental method devised by the authors for solving hydrodynamical problems [see Abstract 3096 (1932)] is here applied to a fundamental equation in Prandtl's aerodynamical theory, where otherwise a lengthy numerical method would be required. J. P. A.

69. Oscillographic Records of the Turbulent Motion Developing in a Boundary Layer from a Surface of Discontinuity. M. Ziegler. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 419–426, 1932.—The apparatus described earlier [see Abstract 3520 (1931)] has been modified slightly, and a diagram of the experimental arrangements is given. Oscillographic records of velocity fluctuations were obtained at about 60 points in the field, and 20 of these are reproduced. The mean velocity is expressed as a function of the distance from the surface of the plate for various distances from the leading edge. Velocity (V) curves obtained for 8 distances (x) from the leading edge are reproduced, and a general map of the velocity distribution is derived. The changes in the character of V for increasing values of x indicate the marked layer of discontinuity at the leading edge for small values of x. The discontinuity becomes more gradual for $x = 10$ to 20 mm. and disappears for $x = 50$ mm. The lability of the layer of discontinuity is shown while the layer divides into separate vortices downstream. For small values of x the rapid fluctuations penetrate into the region of steady flow more than slow waves, but for $x \eqslantgtr 5\cdot3$ mm. the reverse holds. Turbulence is a maximum for $x = 10$ to 20 mm. The sources of error are discussed. R. S. R.

70. Stability of Couette Flow. H. Schlichting. *Ann. d. Physik,* 14. 8. *pp.* 905–936, *Oct.,* 1932.—The stability of Couette flow, *i.e.,* flow of viscous fluid between two parallel planes, one of which is at rest while the other moves with constant velocity in a tangential direction is investigated mathematically. A Reynolds number equal to 19,300 is derived as corresponding to the lowest limit of stability of flow, and hence is to be regarded as the critical Reynolds number for Couette flow. J. S. G. T.

71. Hot-Wire and Spark Shadowgraphs of the Airflow through an Air-Screw. H. C. H. Townend. *Phil. Mag.* 14. *pp.* 700–712, *Oct.,* 1932.—A grid of fine heated wires is mounted near the blades of an air-screw and the character of the flow pattern is observed from the shadows of the hot bands cast by an arc lamp when they are viewed through a stroboscope synchronised with the air-screw blades. Further, the hot wires are replaced by a periodic electric spark which gives a shadow consisting of a stream of dots instead of a continuous band. The dots occur at regular intervals with frequency as high as 1300 per sec., and their shadows have been observed with a wind-speed of 30 ft. per sec. By means of a stroboscope driven by the screw, maps of velocities and directions of small masses of air can be observed at any point in the field. Plates showing photographic reproductions of the flow are given.
H. M. B.

72. Design of Aerofoil Sections. C. Schmieden. *Zeits. f. angew. Math. u. Mechanik,* 12. *pp.* 288–310, *Oct.,* 1932.—The general problem of the design of aerofoil sections free from the danger of cavitation when employed under normal circumstances is discussed, and a method devised for calculating the profiles. Two types of profile are fully considered, namely, profiles consisting partly of straight lines, and those consisting wholly of curves. Practical varieties of these two types are dealt with in detail. J. P. A.

KINETIC THEORY OF MATTER.

73. Relativity Correction to Maxwell's Law of Distribution of Velocities. A. Busemann. *Phys. Zeits.* 33. *pp.* 775–777, *Oct.* 15, 1932. —In the kinetic theory of gases it is shown that the relativity correction for high velocities can be applied by the methods of classical statistical mechanics and the correct law for the velocity distribution deduced. G. C. Mc.V.

74. Optical Investigation of the Collision of Gas Atoms with a Wall of the Enclosure. L. S. Ornstein and W. R. van Wijk. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 722–726, 1932. *In German.*—The collision of a gas atom or molecule against the wall of the containing vessel has been generally studied from the mean value of a property of the molecule. Other methods which allow a more minute study of the process are: (1) molecular ray experiments; and (2) distribution function of rotational energy. Another method involving the distribution function of translational energy, which requires an exact analysis of the form of spectral lines, has been developed by the authors for the case of helium. A brief account is given in the paper and its scope indicated. The spectral tube consists of two coaxial cylinders, the inner one being cooled by water and the outer heated electrically to 320° C. The distance between the walls is 0·1 cm. and the gas pressure 0·01 cm., so that the free path is of the same order of magnitude as the distance between the walls. T. B.

75. Investigations on Radiometers. Part IV. W. Gerlach and W. Schütz. *Zeits. f. Physik*, 78. 1–2. *pp.* 43–58, *Sept.* 8, 1932.—The object of these investigations is to prove experimentally the conclusions of Hettner on the cause of the radiometer effect and to give an experimental proof of the existence of the gas current, *i.e.*, the thermal sliding gas layer along the surface of a one-plate radiometer. Theoretically difficulties occur, since the assumption is made that the free wave-length of the gas molecules is small in comparison with all important dimensions. In the case of gas densities in which there is an appreciable radiometer effect, this does not hold in regard to the thickness of the radiometer plate. Hettner did not give a theory of the one-plate radiometer, but Einstein gave the formula $K = p\lambda\Delta T/T$, which, however, does not allow of a general verification. New interest was given to the problem by Epstein and Sexl, who gave the expressions $K = (8/3)p\lambda^2\Delta T/T$ and $K = (14, 72/(v + 5)\,)p\lambda^2\Delta T/T$ respectively, with the usual notation, n being the degree of freedom of the gas molecule, *i.e.*, $n = 2$ for a diatomic gas. These formulæ are discussed, and then a description, accompanied with graphs, is given of the experimental proof of the existence of the surface gas current by the use of a delicate manometer. The results of measurements of the radiometer effect in air are in agreement with Epstein's formula. In hydrogen the observed effect is greater than the theoretical one. Some reasons for this are suggested. [For Part III see Abstract 1238 (1924).] **Errata,** *ibid.* 79. 9–10, *p.* 700, *Dec.* 15, 1932. T. B.

76. Reflection of Atomic Beams from Sodium Chloride Crystals. R. M. Zabel. *Phys. Rev.* 42. *pp.* 218–228, *Oct.* 15, 1932.—The wave nature of He, Ne and A has been investigated by the reflection of beams of these gases from a freshly cleaved surface of sodium chloride. Evidence of diffraction was obtained in all cases, it being most pronounced in helium and least in argon. Both natural and laboratory grown crystals were used. The laboratory grown crystals were cleaved in moist air, dry air and dry hydrogen. Laboratory grown crystals cleaved in dry air or dry hydrogen reflected a greater percentage of the incident molecules in the specular and diffracted beams than natural crystals or laboratory grown crystals exposed to moist air. The diffraction pattern obtained from crystals which had not been exposed to water vapour was produced by the spacing between rows of Na and Cl ions (1·99 Å.). Crystals which had been exposed to water vapour showed evidence of a spacing twice as long as those which had not been exposed. AUTHOR.

77. Brownian Motion in Fields of Force. J. Métadier. *Comptes Rendus*, 195. *pp.* 649–651, *Oct.* 17, 1932.—Three simple cases of the general result previously deduced [see Abstract 1491 (1932)] are dealt with, in particular the case where the field of force consists of a field independent of time superposed on a uniform field. C. A. S.

See also Abstracts 11, 316.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

78. Measurement of Small Changes of Length. R. Mohr. *Zeits. f. techn. Physik*, 13. 10. *pp.* 477–479, 1932.—Small changes of length are accurately measurable by means of a liquid overflow device in which the volume of the displaced liquid is measured by the advance or recession of a meniscus in a fine capillary maintained in a horizontal position. Applications to expansions of solids, measurement of small pressure differences and of atmospheric pressure are detailed. J. P. A.

79. Determination of the Relationship between Wave-Lengths of Light and the Fundamental Standards of Length. J. E. Sears, Jr., and H. Barrell. *Roy. Soc., Phil. Trans.* 231. *pp.* 75–145, *Sept.* 16, 1932.—An account is given of the apparatus and methods developed at the National Physical Laboratory for the establishment of suitable means of realising a wave-length standard of length and for determining the Imperial Standard Yard and the Standard Metre in terms of it. The apparatus is so designed that the measurements can be made either in air under controlled conditions or in vacuum, and thus provides ready means for a redetermination of the refractive index of air. The method consists of the following stages: The number of waves of the selected monochromatic radiation contained in a Fabry–Perot étalon approaching 10 cm. in length is first measured. The étalon is constructed of invar tube, with chromium-plated, optically flat and parallel ends on to which the silvered glass or quartz plates are wrung, forming an airtight enclosure. This étalon is compared with a second of intermediate length by the use of Brewster's fringes in white light, and this is compared in turn with a third, slightly longer than the standard, by the same method. The difference, in wave-lengths, between the third étalon and an end-gauge of length nominally equal to the standard is next determined. The end-gauge is made of steel, of X-section, with polished ends, and is mounted inside the étalon. The difference between it and a composite gauge of special construction is measured in terms of the same monochromatic wave-length in an optical comparator, and, finally, the composite gauge is compared in a line-standard comparator with a line-standard whose relationship to the prototype can be similarly measured. Details are given of each part of the apparatus and of each stage of the method, including the accurate control of temperature, the sources of monochromatic radiation, and of the corrections to be applied. Some provisional results are also tabulated. The paper has two Appendices: "Production of Hard Surfaces on Invar Étalons by Electroplating," by **F. Adcock** and **H. Barrell**, and "Temperature Measurements," by **J. A. Hall** and **H. Barrell**. The latter contains an account of the platinum resistance thermometers, and the method of measuring resistances, used in the thermostat in the main experiments. C. B. A.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

80. Tables of the Elliptic-Cylinder Functions. E. L. Ince. *Roy. Soc. Edinburgh, Proc.* 52. *pp.* 355–433, *Oct.* 1, 1932.—Reference is made to a solution given by the author in 1924 to obtain tables of the elliptic functions given by the Mathieu equation $d^2y/dx^2 + (a - 2\theta \cos 2x)y = 0$. The tables enable solutions to be obtained of the classical problems of the ellipse and the elliptic cylinder in mathematical physics, and it is considered they may be of value in such problems as the theory of oscillating electrical circuits which depend upon periodic solutions of a Mathieu equation. The tabulation of any particular Mathieu function involves (1) determination of the characteristic number, (2) calculation of the ratios of consecutive Fourier coefficients and subsequent determination of the actual coefficients in accordance with the chosen definition of the function, and (3) computation of the function from the Fourier series. Four machines were used in making the calculations. The tables were calculated for the first ten integral values of θ, that is for only one-half of the number of cases for which the coefficients were worked out and one-quarter of their range. Finally the zeros and turning points of the twelve elliptic cylinder functions of lowest order (when they exist in the interval $\theta < x < \frac{1}{2}\pi$) are tabulated respectively for a set of positive values of θ. The entries represent degrees. The method is outlined by which tables for θ negative can be obtained. Interpolation to the degree of precision required by ordinary physical applications is usually possible, except at the beginning of the entries in the first column of turning points of the even functions. The graphs of these particular turning points are orthogonal to the θ-axis. R. S. R.

81. Expansion for Laplacean Integrals in Terms of Incomplete Γ-Functions. E. C. Molina. *Bell System Techn. J.* 11. *pp.* 563–575, *Oct.*, 1932.—The definite integral $\int_x^{x_2} \gamma_1^{\theta_1}\gamma_2^{\theta_2} \ldots \gamma_n^{\theta_n}\phi dx$, where $\gamma_1, \gamma_2 \ldots \gamma_n$ are functions of x whose exponents $\theta_1, \theta_2 \ldots \theta_n$ are of the order of magnitude of a large number θ and ϕ embraces all factors whose exponents are of a lower order, is evaluated in terms of incomplete Γ-functions. Some special cases of this type of integral are considered. G. C. McV.

82. Physics and Method of Coincidences. W. Bender. *Frank. Inst., J.* 214. *pp.* 443–463, *Oct.*, 1932.—By an analysis of the method in which scale measurements are made, a scheme of mathematical physics is formulated in which difference, instead of differential, equations are used; it also leads naturally to quantisation of physical quantities.

G. C. McV.

83. Theory of Errors and Least Squares. H. Jeffreys. *Roy. Soc., Proc.* 138. *pp.* 48–55, *Oct.* 1, 1932.—It is shown that in the absence of previous knowledge of the probable degree of precision of a set of observations, the probability of a value of h, the precision constant, lying within the range dh is proportional to dh/h. This result, applied to the theory of least squares, indicates that when the number of observations is small, the probability of error is more widely distributed than is given by the usual formula. In the extreme case of two observations and one unknown, the probable error of the mean is equal to the standard deviation.

J. S. G. T.

84. Probable Error of the Slide Rule. D. L. MacAdam. *Rev. Sci. Instruments,* 3. *pp.* 620–625, *Oct.,* 1932.—Slide rules of various makes were compared by carrying out 100 multiplications with each and comparing the results with those given in Crelle's tables. For a 10-in. straight rule of the log-log type the probable error was 0·045. Another rule had a single spiral scale with an outside diameter of 10 in. and a total length of 47·5 ft. The probable error was in this case 0·0024 %. E. E. F. d'A.

MECHANICS, CLASSICAL.

85. Hydrodynamical Demonstration of Gyrostatic Forces. J. Jaumann. *Phys. Zeits.* 33. *pp.* 734–736, *Oct.* 1, 1932.—Many of the properties of the gyrostat may be demonstrated with a model consisting of a tube bent into the form of a rectangle, and carrying a stream of water flowing with uniform speed. The rectangle, which is suspended in a vertical plane in such a manner that it can turn about a vertical axis through its centre, and can oscillate about its upper horizontal side, deflects from the vertical when rotated about its vertical axis, or will rotate if deflected from its vertical plane. Other gyrostatic properties are detailed, and a more complicated apparatus on the same principle described. J. P. A.

See also Abstracts 73, 78, 97, 98, 130.

MECHANICS, QUANTUM.

86. Dirac's Equation in General Relativity. G. C. McVittie. *Roy. Astron. Soc., M.N.* 92. *pp.* 868–877, *Oct.,* 1932.—A generalised form of Dirac's equation, proposed by Schrödinger [see Abstract 4119 (1932)] and valid in any Riemannian manifold, is solved for the case of a hydrogen atom in any orthogonal gravitational field. The solution is taken to the first approximation in the quantities giving departure from the Euclidean case. The results give the observed displacement of spectral lines to the red in the field of the sun or a star and show that the frequency of light emitted by an atom is unaffected by the expansion of space. G. C. McV.

87. Dirac's New Field Theory. S. Schubin. *Zeits. f. Physik,* 78. 7–8. *pp.* 539–540, *Oct.* 12, 1932.—Dirac's new field theory [see Abstract 3581 (1932)] eliminates the explicit introduction of the Coulombian force of interaction between material particles, but Dirac's earlier theory of the emission and absorption of light, which led to correct results, involves the explicit use of the Coulombian force. The author indicates that

Dirac's earlier theory contains compensatory errors, and that in fact the contradiction with the new theory is only apparent. W. S. S.

88. Extension of the Dirac Operators in Quantum Mechanics. T. Iwatsuki and Y. Mimura. *Hiroshima Journ. Sci.* 2. *pp.* 207–212, *Oct.*, 1932. *In English.*—Calculation principles are established for the extension of Dirac operators for a group which is more general than the Lorentz group, and are applied to a set of independent functions, and to obtain the extended Dirac operators. N. M. B.

89. Equivalence of Corpuscular and Wave Interpretations of Negative Electricity in Quantum Theory. R. Einaudi. *Accad. d'Italia, Mem.* 3. 1. (*Fisica*). [30 *pp.*], 1932.—The author considers the system consisting of a number of electrons and their electromagnetic field of interaction confined in an enclosure with perfect reflecting walls, the whole being immersed in a steady external electromagnetic field. The electrons are assumed to conform to Dirac's wave equation. The electromagnetic field is quantised, and this can be done in two ways. The classical electromagnetic equations are taken as basis, assuming the electric charge to consist (*a*) of point electrons each having a definite velocity (corpuscular interpretation), (*b*) of a continuous distribution in space determined by the wave function (wave interpretation). In both cases it is possible to specify the electromagnetic field in terms of a system of canonical variables which can be at once replaced by quantum operators. Thus, two systems of equations are derived each of which determines the quantum theory probability of any particular state of the complete system, electrons and electromagnetic field. The author finds that the exact equivalence of the two solutions is assured, provided the form of the operators associated with the variables describing the electron waves is suitably chosen. In the analysis the electrons of the system are assumed to obey the Fermi statistics. W. S. S.

90. Analytic Atomic Wave Functions. J. C. Slater. *Phys. Rev.* 42. *pp.* 33–43, *Oct.* 1, 1932.—A method is suggested for setting up analytic atomic wave functions which form good approximations to Hartree's functions. These functions are of the form $\sum cr^n e^{-ar}$, where the exponent a as well as c and n vary from one term to another. The constants are determined for 1, 2 and 3-quantum electrons by fitting Hartree's values numerically for five selected atoms, and interpolation methods are presented for dealing with the intermediate atoms. A method is suggested for setting up exactly orthogonal functions, with no loss of accuracy. It is shown that the analytic wave functions are the solutions of central field problems in which the field is slightly different for different quantum numbers, on account of the inaccuracy in the function, but a table shows that the discrepancy between this and the correct field is small over the region where the wave function is large. Suggestions are made for future work, on the one hand in extending the tables, on the other in using the wave functions in investigating atomic energies, exchange integrals, etc. AUTHOR.

91. Atomic Eigenfunctions and Energies. C. W. Ufford and G. H. Shortley. *Phys. Rev.* 42. *pp.* 167–175, *Oct.* 15, 1932.—The calculation of the non-diagonal elements of electrostatic interaction is sketched. Attention is called to the fact that the matrix elements of L_x (the x-component of orbital angular momentum), as calculated between spherical harmonic eigenfunctions taken with positive phase, are negative when m_l is + and positive when m_l is −. The calculation of eigenfunctions in LS coupling has always been done, using only positive matrix elements of L_x. This amounts effectively to using a zero-order scheme in which one takes spherical harmonic eigenfunctions with negative phase for positive odd values of m_l, and positive phase for all other values. The calculation of first order energies for configurations which give more than one multiplet of a kind is considered, and explicit formulæ given for the electrostatic energies and magnetic splitting of the two ^{2}D's of d^3. The results are shown to compare satisfactorily with the observed data. The second ^{2}D is predicted in general to be extremely high and inverted.

AUTHORS.

92. Theory of Electric Charge. A. S. Eddington. *Roy. Soc., Proc.* 138. *pp.* 17–41, *Oct.* 1, 1932.—The theory of the fine structure constant, $hc/2\pi e^2$, partially developed in previous papers [see Abstracts 701 and 1515 (1932)] is completed. The value 137 for this constant is derived by pure deduction, employing only fundamental hypotheses of wave mechanics. Starting from the principle that the wave equation expresses the conservation of probability in a steady state, it is pointed out that, owing to interchangeability, the conservation of probability for two charges is not a simple extension to eight dimensions of the result for one charge in four dimensions. A new direction of flow of probability between the two configurations corresponding to interchange must be added. The Fermi–Dirac law of antisymmetry is deduced, and it is shown that this quantises the flow in the new direction. It is found that the same state, *i.e.*, distribution of probability, repeats itself 137 times as frequently along the cyclic coordinate corresponding to interchange compared with the other cyclic coordinates corresponding to excitation. The matrix associated with the interchange energy differs from that given in previous papers and reduces, in special cases, to the form $(1 + (\sigma, \sigma'))/2$ commonly used in non-relativity theory. J. S. G. T.

93. Energy of the Configuration (1s)^2(2s). K. Ochiai. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 388–396, *Sept.*, 1932. *In English.*—An approximate method of integration of Fock's equation [see Abstract 2448 (1930)] applied to the simple case $(1s)^2(2s)$ is given. Starting with purely hydrogenic wave functions without introducing any adjustable parameter, an expression for the energy is obtained. Numerical calculation shows that the energy values thus obtained agree with experimental ones tolerably well.

AUTHOR.

94. Five-Electron Problem in Quantum Mechanics and its Application to the Hydrogen–Chlorine Reaction. G. E. Kimball and H. Eyring. *Am. Chem. Soc., J.* 54. *pp.* 3876–3885, *Oct.*, 1932.—Slater's treatment of the 3- and 4-electron problems is applied to the problem of 5 electrons with spin degeneracy, and the result is used to calculate the activation energies of the reactions $Cl_3 + H_2 = Cl_2 + HCl + H$, $H + Cl_2 + H_2 = 2HCl + H$, and $Cl + H_2O + H_2 = HCl + H_2O + H$. It appears that none of these reactions occur in the photochemical reaction between H and Cl, which must proceed by the chain $Cl + H_2 = HCl + H$; $H + Cl_2 = HCl + Cl$. H. F. G.

95. Asymptotic Integration of the Differential Equation Relating to the Thomas–Fermi Atom. A. Sommerfeld. *Zeits. f. Physik,* 78.

5–6. *pp.* 283–308, *Oct.* 4, 1932.—Asymptotic solutions of the Thomas-Fermi differential equation are derived by the application of a method due to Emden, and applied to the discussion of ionic diamagnetism, ionising potentials associated with the discontinuous disintegration of atoms, etc., and the scattering of electron waves by heavy atoms. J. S. G. T.

96. Quantum Mechanics. P. Ehrenfest. *Zeits. f. Physik,* 78. 7–8. *pp.* 555–559, *Oct.* 12, 1932.—The author discusses very briefly, principally by way of queries, the occurrence of the complex scalar ψ in Schrödinger's wave equation, the want of analogy between photon and electron, and the difficulty of approach to the study of spinor calculus. J. S. G. T.

97. Concept of Causality. M. Planck. *Phys. Soc., Proc.* 44. *pp.* 529–539, *Sept,* 1932.—If a causal link between two successive events is taken to mean a certain connection, subject to law, between the two events, of which the earlier event is called the cause and the later one the effect, then the question is, in what does this particular kind of connection consist? As a starting point one may then state the proposition: An event is causally conditioned if it can be predicted with certainty. Experimental physics teaches, however, that in not a single instance is it possible to predict a physical event exactly. This fact leads indeterminists to attribute all physical laws ultimately to chance, so that nature is regarded as being governed by statistics alone, and physics becomes based on the calculus of probability. To escape from this point of view it is necessary to modify the above proposition taken as a starting point by recollecting that it is not to one single actual measurement that the theoretical physicist gives the name of event; there are always casual and unessential factors involved. The physicists' world-picture is a mental construction, arbitrary to a certain extent, an idealisation created for the purpose of escaping from the uncertainty which is inherent in every individual measurement; this enables the physicist to establish sharply defined conceptual relationships. The introduction of this world-picture reduces the uncertainty in the prediction of an event of the world of sense, to the uncertainty of the translation of the event from the world of sense to the world-picture and *vice versa.* The author then applies this line of argument to the new world-picture of quantum physics. He points out finally that the law of causality is neither right nor wrong, but rather is to be regarded as a heuristic principle. H. L. B.

98. Planck and the Principle of Causality in Physics. A. Ferguson. *Nature,* 130. *pp.* 45–48, *July* 9, 1932.—The development of the concept of causality since the age of Newton is briefly considered. The first clearly ordered statement of the experientialist doctrine of causation is due to Hume. Mill carried Hume's ideas still further, and pointed out that invariable sequence does not necessarily involve the notion of causation. Kant's views played no decisive part in the development of scientific theory in this or in the last century. Kirchhoff regarded it as the task of mechanics to describe as completely and as simply as possible the motions that occur in nature. A *résumé* is then given of the way in which Planck in his Guthrie Lecture [see preceding Abstract] sets out to answer the question as to how the ideas of causality and scientific explanation of the twentieth century have been modified by recent discoveries. H. L. B.

99. Statistical Mechanics with Particular References to the Vapour Pressures and Entropies of Crystals. R. H. Fowler and

V.
19

T. E. Sterne. *Rev. Modern Physics*, 4. *pp.* 635–722, *Oct.*, 1932.—A comprehensive article, containing nine chapters and two appendices. Though already thoroughly understood, monatomic substances are included for the sake of completeness: the extension to diatomic bodies is now considered to be satisfactory, and is treated in great detail. Nernst's theorem, in its generality, is rejected, and the old name " chemical constant " is taken to have outgrown its usefulness. The term " vapour pressure constant " is already in use, and its retention is suggested.

F. I. G. R.

See also Abstracts 8, 101, 102, 103, 248, 249, 378, 379.

RELATIVITY AND ETHER.

100. Riemannian Manifolds and Non-Euclidean Space-Forms. P. Koebe. *Preuss. Akad. Wiss. Berlin, Ber.* 16. *pp.* 249–284, 1932.—The synthesis and metric theory developed in previous work [see Abstract 1871 (1932)] is extended to convex and concave space-forms. J. S. G. T.

101. Einstein and Mayer's Theory and Dirac's Equations. J. Solomon. *Comptes Rendus*, 195. *pp.* 461–462, *Aug.* 22, 1932.—The connection between the unitary field theory of Einstein and Mayer [see Abstracts 705 and 2309 (1932)] and the relativistic equation of Dirac is discussed. The theory proposed makes it possible to deduce from the geometrical postulates of the theory of Einstein and Mayer the significance of the vector ϕe which is left open in the earlier theories of Dirac's equation for the gravitational field. H. L. B.

102. Unitary Field Theory. J. A. Schouten and D. van Dantzig. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 642–655, 1932. *In German.*—By means of projective differential geometry and the method of homogeneous coordinates introduced by v. Dantzig, the authors work out a unitary field theory different from that of Einstein–Mayer and from that of Veblen–Hoffmann, and having five advantages over both. It yields the correct equations and the correct Riemannian geometry for the purely gravitational field. Also the Dirac equation for the electron in its simplest form, including a mass term; a covariant constancy of the point of total impulse energy; and the simplest possible principle of variation for the origin of the field equations. [See following Abstract.] E. E. F. d'A.

103. Unitary Field Theory and Dirac's Equation. J. A. Schouten and D. van Dantzig. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 843–852, 1932. *In German.*—In a previous communication [see preceding Abstract] the authors showed that in the projectivated equation of world lines the fully defined potential energy point takes the place of the vector of electromagnetic potential. They now show that the projectivised Dirac equation may be reduced to a form which also contains only this point of impulse energy. The operator $\frac{h}{i}\nabla_\mu$ is then equivalent, in the sense of the quantum theory, with the total impulse energy point p_μ, and the operator appearing behind a^μ in the Dirac equation is equivalent to a point on the fundamental quadric. From this form of the Dirac equation there results Hamilton's function, which, within a certain factor $1/2m$, is nothing but the scalar product of this point with the complex conjugate point lying on the same quadric. This form of Hamilton's function yields the correct equations for the world lines. [See also following Abstract.] E. E. F. d'A.

104. Unitary Field Theory. J. A. Schouten and D. van Dantzig. *Zeits. f. Physik*, 78. 9–10. *pp.* 639–667, *Oct.* 18, 1932.—In continuation of their work [see two preceding Abstracts] the authors endeavour to present their theory more from a physical point of view. As in the ordinary relativity theory each world-point is associated with a local four-dimensional manifoldness (the local E_4^{*-1}) which, however, is not of Euclidean, but projective nature. A fixed point, *viz.*, the point of contact, of the local E_4^* is to be identified with the corresponding space-time point, with corresponding provision for the infinitesimal neighbourhood of that point. But whereas in Riemann's geometry finite vectors may be regarded as suitably measured differentials, in this case the points lying in E_4^* at a finite distance from the point of contact cannot be obtained from the space-time world. The authors compare their theory with that of Veblen and Hoffmann on the one hand and with that of Einstein and Mayer on the other, and conclude that it fulfils the conditions best. E. E. F. d'A.

105. Red Shift of Light from Spiral Nebulæ. H. E. Buc. *Frank. Inst., J.* 214. *pp.* 197–198, *Aug.*, 1932.—If a quantum of light loses energy as it travels through space, at a rate determinable from the red-shift of the light from the spiral nebulæ, this red-shift can be accounted for without postulating the expansion of the universe. G. C. McV.

106. Physical and Observational Evidence for the Expanding Universe. J. H. Reynolds. *Nature*, 130. *pp.* 458–462, *Sept.* 24, 1932.—An account of the methods of estimating the distances of the nebulæ and of their velocities of recession as deduced from the displacements of their spectral lines. The numerical values of the distances and velocities are given for some thirty nebulæ. G. C. McV.

107. Expanding Universe. W. de Sitter. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 596–607, 1932.—A classification of the types of "expanding universes" according to the value, positive, negative or zero, of the cosmical constant, λ, and the curvature of three-dimensional space, is made. It is shown that observational evidence can, at present, determine neither the sign nor the value of these quantities. The hypothesis is put forward that the apparent shortness of the time-scale provided by the expansion theory is due to the assumption that the development of the spiral nebulæ and of stars only began when the expansion started. Reasons are given for supposing that the expansion started much later. G. C. McV.

108. Expanding Universe. D. D. Kosambi and E. A. Milne. *Nature*, 130. *pp.* 507–508, *Oct.* 1, 1932.—Kosambi shows that Milne's theory, which accounts for the displacement of the spectral lines of the nebulæ by ascribing it to real velocities with respect to the coordinate system of the observer, still holds when the mutual collisions and attractions of the nebulæ in Euclidean space are allowed for. Milne, in a note, refers to the fact that his theory holds even when the nebulæ originally filled the whole of Euclidean space provided they were concentrated around one point. G. C. McV.

See also Abstracts 86, 87, 92.

SOLUTION.

109. Solvent Influence on Solubility of Salts and Activity Coefficients of Ions. J. N. Brönsted, Agnes Delbanco and K. Volqvartz. *Zeits. f. phys. Chem.* 162. *Abt.A.* 1–2. *pp.* 128–146, *Oct.*, 1932.—Based on measurements of the solubility of cobalt ammonium salts in different solvents, *e.g.*, methyl alcohol solutions of sodium perchlorate, sodium iodoacetate, barium chlorate, strontium trichloroacetate and manganese benzene sulphonate, agreement is found for monobasic salts with the Debye–Hückel theory, but otherwise the agreement is not so good. Solubility measurements of a series of cobalt ammonium salts have also been made for water and methyl alcohol and the ionic distributions calculated. The solubilities of the non-electrolytic trinitrotriammine cobalt (S_1) and isomeric salts (S_2) in a series of solvents show that a simple mathematical relation exists between S_1 and S_2. Born's electrostatic formula is found to be not directly applicable to the distribution data. The conceptions of individual ionic potentials and of ionic activity coefficients are discussed. H. H. Ho.

110. Solvent Properties of Soap Solutions. Part III. System Sodium Oleate, Sodium Chloride, Water, Ethyl Acetate. E. L. Smith. *J. Phys. Chem.* 36. *pp.* 2455–2473, *Sept.*, 1932.—In the present work is examined a quaternary system comprising a pure soap, a salt of the same base, water and an organic liquid. The four ternary systems and the quaternary system possible with the four components, sodium oleate, sodium chloride, ethyl acetate and water at 25° C. are described. It is shown that the system sodium oleate, sodium chloride, water is peculiar in that it constitutes an exception to the phase rule. The components sodium oleate, ethyl acetate and water yield the six phases: isotropic sodium oleate solution, middle soap, neat soap, curd soap, wet ethyl acetate and vapour. The nature of the solubility of ethyl acetate in sodium oleate is discussed. [For Parts I and II, see Abstract 4652 (1932).] J. K.

See also Abstracts 17, 18, 43.

SURFACE TENSION AND COHESION.

111. Volume of the Meniscus at the Surface of a Liquid. A. W. Porter. *Phil. Mag.* 14. *pp.* 694–700, *Oct.*, 1932.—Calculations are made to find the volume V of the meniscus at the surface of a liquid, *i.e.*, the volume enclosed by a tangent plane through the mid-point, the liquid surface itself and the wall of the vessel. Tables are already in use, but the range is small and further information is desirable. Using Bashforth and Adams' tables, graphs and tables are given showing how the volume V varies with radius of the tube and the angle of contact for cylindrical and conical tubes. H. M. B.

112. Surface Tensions of Ethyl Ether, Acetone, Toluene and Methyl Alcohol at Low Temperatures. T. Tonomura and K. Chujo. *Chem. Soc. Japan, Bull.* 7. *pp.* 259–264, *Aug.*, 1932.—The surface tensions are measured by the capillary-rise method over the temperature range −100° to +30° C., and the corresponding Eötvös relations are calculated, *viz.*, ethyl ether, $\gamma(M/D)^{\frac{2}{3}} = 2\cdot2261(T_c - 8\cdot62)$, acetone $\gamma(M/D)^{\frac{2}{3}} = 1\cdot8516(T_c + 1\cdot808)$; toluene, $\gamma(M/D)^{\frac{2}{3}} = 2\cdot4109(T_c - 39\cdot05)$;

and methyl alcohol, $\gamma(M/D)^{2/3} = 560\cdot89 - 1\cdot12481T + 0\cdot000333186T^2$, in which γ is the surface tension at a temperature T_c °C. above the critical temperature, T is the absolute centigrade temperature, M the molecular weight and D the density. For methyl alcohol constants could not be found to fit the Eötvös equation (owing probably to association), and the straightforward quadratic relation is preferred. L. V. C.

113. Surface Tension of Malonic Esters and Constitutive Nature of the Parachor. A. B. Beck, A. K. Macbeth and S. W. Pennycuick. *Chem. Soc., J. pp.* 2258–2262, *Aug.*, 1932.—The surface tensions of 12 unsubstituted and of 10 substituted alkyl malonic esters are determined by Sugden's method. The derived values of the parachor differ from those calculated, (i) using Sugden's constants, and (ii) using the modified constitutive constants of Mumford and Phillips [see Abstract 496 (1930)]. Further constitutive factors are suggested. L. V. C.

114. Apparatus for Making Minute Glass Instruments. P. de Fonbrune. *Comptes Rendus*, 195. *pp.* 706–707, *Oct.* 24, 1932.—A method is described of drawing a small glass bead into a minute needle point by means of a fine wire heated electrically, provided with the necessary mechanical movements and mounted under a microscope. The shape of the point is controlled by the current through the wire, the time taken to draw out the needle, and the strength of a current of air which passes over the apparatus. The arrangement can be used to make various devices, such as needle points, micropipettes or minute capillary tubes. W. D. W.

See also Abstracts 1, 40.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

115. Automatic Time-Recorder. L. A. Richards and L. A. Wood. *Rev. Sci. Instruments*, 3. *pp.* 616–619, *Oct.*, 1932.—A time-recorder registering 0·0001 sec. is secured by interrupting a beam from a 32-c.p. lamp shining on a photoelectric cell. E. E. F. d'A.

See also Abstract 134.

VACUA, HIGH.

116. Improved McLeod Gauge and Manometer. H. S. Booth. *Indust. & Engin. Chem.* (*Analytical Edition*) 4. *pp.* 380–382, *Oct.* 15, 1932.—The new design permits measurements of pressure over a wide range (760 to 1×10^{-5} mm.). Two forms are described and illustrated, and in a table suitable dimensions for the component parts are given. The method of operation of the gauge, and precautions to be observed, are described. R. S. R.

See also Abstract 66.

VISCOSITY. FRICTION AND LUBRICATION.

117. Viscosity of a Fluid Containing Small Drops of Another Fluid. G. I. Taylor. *Roy. Soc., Proc.* 138. *pp.* 41–48, *Oct.* 1, 1932.—Einstein's expression for the viscosity of a fluid containing solid spheres is extended to include the case of liquid spheres. The expression derived is valid provided the surface tension is sufficient to maintain the drops nearly spherical. When the rate of distortion of the fluid or the radius of the drop is large enough, the drops tend to break up. An approximate expression for the size of the largest drop that can exist in fluid undergoing distortion at any given rate is derived. J. S. G. T.

118. Viscosity of Strong Electrolytic Solutions According to Electrostatic Theory. H. Falkenhagen and E. L. Vernon. *Phil. Mag.* 14. *pp.* 537–565, *Oct.*, 1932.—The viscosity of electrolytes in which the ions have unequal mobilities is calculated with the aid of the conception of an ionic atmospheric surrounding the individual ions. The results are tested against recent experimental determinations. J. H. A.

119. Effect of Magnetic Field on Viscosity of Oxygen. H. Engelhardt and H. Sack. *Phys. Zeits.* 33. *pp.* 724–727, *Oct.* 1, 1932.—A change in viscosity under the influence of a magnetic field was anticipated, by analogy with the results on thermal conductivity. The change in viscosity (and not the absolute value) was found by means of a hydrodynamic "Wheatstone bridge" in which four capillaries are arranged, with a flow meter of the type described by Hess in place of the galvanometer. One capillary only is surrounded by a solenoid to produce the magnetic field. The viscosity of oxygen decreases by about 0·5 % in a field of 2000 gauss, at each of the two pressures used, *viz.*, 110 mm. Hg and 64 mm. Hg. When air is used in place of oxygen, the change in viscosity is reduced to about 1/6 of its value in pure oxygen, whilst in pure nitrogen no effect could be detected. J. H. A.

120. Viscometer for Volatile and Hygroscopic Liquids. E. N. da C. Andrade and K. E. Spells. *Journ. Sci. Instruments*, 9. *pp.* 316–319, *Oct.*, 1932.—Description of a viscometer, based on the Ostwald form, which enables measurements to be made with the apparatus completely enclosed, without rubber tubing or greased joints. The resetting is carried out by a magnetically actuated iron plunger in a truly cylindrical glass tube. An example is given of the accuracy attainable with a benzene solution. AUTHORS.

121. Viscosity of Gelatin under X-Rays. Helen Q. Woodard. *J. Phys. Chem.* 36. *pp.* 2543–2553, *Oct.*, 1932.—The viscosity of dilute gelatin sols is decreased by heavy doses of X-rays. When the viscosity of a gelatin sol is reduced by heat, by pH change, or by addition of salts, the reduction in viscosity due to subsequent irradiation is decreased. When the initial reduction is due to ageing or irradiation, the lowering in viscosity due to subsequent irradiation is decreased, but in a manner too irregular for quantitative interpretation. When initially reduced by dilution, the lowering in viscosity due to subsequent irradiation is not changed. E. E. F. d'A.

See also Abstracts 18, 19, 275, 312.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

122. Synchronous Motor Operation of Astronomical Telescopes. G. W. Moffitt. *Rev. Sci. Instruments,* 3. *pp.* 499–510, *Sept.,* 1932.—Attention is drawn to the limited power and other drawbacks of weight-driven clocks for driving astronomical telescopes. Synchronous motors can be used as driving clocks provided that the frequency of supply is controlled with sufficient precision. The author considers typical frequency curves in relation to the requirements of astronomical telescopes, and concludes that, with an accuracy of frequency control already available or attainable, synchronous motor driving of even the largest telescopes would give excellent results. Formulæ are given for determining the permissible variation in frequency in any particular case. The synchronous motor drive of the converted Bruce telescope (Yerkes Observatory) is fully described. If the frequency of public electricity supply is not sufficiently closely controlled, a small private generating system can be installed to secure the requisite precision. Six different arrangements are suggested, most of them involving the production of a d.c. supply, which is fed to a motor-generator set. Any one of a number of different methods may be used to keep constant the frequency of the secondary generator output. The entire cost of the generating plant, motors and gear trains for several telescopes would not be more than that of a single weight-driven clock for a large telescope. R. E. N.

123. Nature of Dependences in Reduction of Astrographic Plates. H. C. Plummer. *Roy. Astron. Soc., M.N.* 92. *pp.* 892–895, *Oct.,* 1932.—Where many plates with the same centre are to be reduced by the same comparison stars, Schlesinger's method of dependences is used. The relations are put in symmetrical form; for three comparison stars, the probable error is a minimum when the object star is at the centroid of the triangle formed by the comparison stars. The same rule is shown to apply for larger numbers of stars; and the dependences are in general proportional to perpendiculars on a polar with respect to the momental ellipse of the mass system defined by the comparison stars. T. L. M.

See also Abstracts 137, 227.

COMETS AND METEORS.

124. Motion of the Periodic Comet Kopff (1906 e). Part I. F. Kepinski. *Acad. Polonaise Sci. et Lettres, Bull. No.* 1–7 *A. pp.* 34–45, *Jan.–July,* 1932.—An historical account is given of the discovery of the comet Kopff (1906 *e*) and the calculations of its orbit. The derivation of the system of orbital elements from observations of a single opposition require correction. The author calculates the perturbations caused by the planets Jupiter, Saturn, Mars and the earth on the comet in the years 1919–1926. This allows the initial elements to be corrected, and yields a basis for calculating the perturbations of the comet until the next opposition in 1932. H. L. B.

125. Stellar Perturbations of Nearly Parabolic Orbits. E. Öpik. *Am. Acad., Proc.* 6. *pp.* 169–183, *Oct.,* 1932.—The perturbation of a meteor (or comet or wide double star) in the aphelic portion of a very elongated orbit by passing stars is considered. Reasonable assumptions are made as to mass and relative velocity of star, frequency of such appulses, etc. The perturbations are shown to increase the perihelion distance systematically if the aphelion distance is large, say, over 2000 astronomical units. Hence meteors or comets of aphelion distance over 10,000 astronomical units are not likely to come within observable distance. Estimates of perturbations in inclination, compared with the distribution of observed inclinations, suggest that observable comets do not go beyond 2000 astronomical units. The theory affords an estimate of the extreme limit of the solar system at 10^6 astronomical units. Since the nearer objects have comparatively stable orbits, the heating effect of the sun may be estimated; this may suffice to expel the helium content so reducing the apparent age on the radium method. The paper is related to the systematic Harvard meteor research. T. L. M.

126. Average Diminution of Major Axis in the Capture of Parabolic Comets by Major Planets. J. Bosler. *Bull. Astronomique*, 7. 5. *pp.* 165–171, 1932.—The initial orbit is assumed parabolic, direction random; the mean effect of a close approach to a planet is examined, with special reference to the average value of the inverse of the semi-major axis. After a first approach, the result for the case of Jupiter is: $a = 6050$ astronomical units. The mean effect of subsequent approaches is, in general, very much less, in the special case 3×10^6 times less, but special cases where large later effect is possible are mentioned. T. L. M.

COSMOGONY.

127. Transmutation of Elements in Stars. G. Steinsholt. *Zeits. f. Astrophysik*, 5. 2. *pp.* 140–152, *Sept.* 30, 1932. *In English.*—Numerical integrations of some stellar models are carried out to test whether synthesis of elements by proton capture, as suggested by Atkinson, can account for the known characteristics of stars. The actual theory of capture follows the lines of Wilson; and the star is supposed to consist mainly of hydrogen and to possess a constant absorption coefficient. It is found that sufficient energy can be generated at the temperatures of an Eddington star, in formal confirmation of Atkinson's theory. The density of the star increases at first with increasing distance from the centre, which involves convective instability of the kind discussed by Rosseland [see Abstract 3681 (1932)]. R. d'E. A.

128. Origin of the Solar System. H. Jeffreys. *Roy. Astron. Soc., M.N.* 92. *pp.* 887–891, *Oct.*, 1932.—A reply to some criticisms, and an explanation of some points misunderstood by Nölke, regarding the author's collision theory. The theory has this advantage over all others, that it leads to quantitative results which are in agreement with facts, for it offers direct explanations of the total mass of the planets, the rate of rotation of the sun and the total rotational angular momentum of the planets. Nölke's own theory, that the solar system evolved by condensation from an arm of a nebula, can explain only one stage, and leaves unanswered questions concerning the previous stages. M. A. E.

129. Structure and Internal Motion of a Gaseous Disc as Original State of the Planetary System. H. P. Berlage, Jr. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 553–562, 1932.—The model of a nucleus surrounded by a massless envelope is assumed, and the fundamental equations of equilibrium are discussed. For the case of isothermy, the angular velocity is a function of the distance from the sun. The decrease of density in the axial direction is computed and found to be very rapid. An approximate case, introducing viscosity effects, is solved for density in the equatorial plane; a maximum is found near the distance of the earth. A planet in a zone of outward increasing density will draw away from the sun owing to excess of angular velocity in such a zone of the disc; and *vice versa*; and this agrees with the departures from a modified form of Bode's law. Zones of turbulence account for the planetoids and "plutoids." T. L. M.

130. Momentum Relations in Crossed Fields. L. Page. *Phys. Rev.* 42. *pp.* 101–107, *Oct.* 1, 1932.—It is shown that the mechanical linear or angular momentum gained by ions moving in crossed electric and magnetic fields is at the expense of the electromagnetic linear or angular momentum already present. Hence Ross Gunn's theory of the acquisition of angular momentum by a star as the result of ion motions in its external electric and magnetic fields cannot be upheld. Three cases are analysed in detail: (*a*) Newtonian motion in uniform crossed fields, (*b*) Newtonian motion in the field of a uniformly magnetised charged sphere, (*c*) relativity motion in uniform crossed fields. AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

131. Comparison of Methods of Determining Planetary Orbits. N. Stoyko. *Bull. Astronomique*, 7. 5. *pp.* 177–200, 1932.—The author commences from his conclusions as to the inter-relation of methods [see Abstract 3188 (1932)]. He tabulates the number of operations involved in first and second approximations by 25 types of method, with some notes as to relative accuracy. To test the latter further the author has applied 44 formulæ to the same sets of observations of the same planet, first over a long interval, 76 days, then over a short, 5 days. The precision of each formula is shown in tabular form. For long interval, the order is: Gibbs, Oppolzer, etc.; Andoyer, Ebert, Moulton, etc.; methods based on Gauss (Noumerov, Wilkens); Gauss–Encke methods; quasi-Laplace methods are twice as accurate as Laplace methods, but have no advantage over Gauss–Lagrange methods. For short interval, the first four classes have no relative advantage but are much preferable to approximate methods: Gauss–Lagrange and best quasi-Laplace methods, four to six times error of accurate methods; the only Laplace method not very much more erroneous was Leuschner's. The author recommends Ebert's formula for first approximation; if a second is necessary, Hansen, Gibbs, or Harker; a syllabus of formulæ is appended. T. L. M.

132. Effect of the Tides in Limiting the Motion of a Planetary System. G. Krall. *Comptes Rendus*, 195. *pp.* 485–487, *Aug.* 29, 1932.—By following a suggestion made by Lord Kelvin, the author has succeeded in proving that in the Kepler motion of two gravitating celestial bodies, whose masses bear any arbitrary ratio to one another and each of which has a precessional motion, not only is there a tendency for the trajectories to become circular, but the precessions also tend to become rotations, their axes of rotation tending to dispose themselves normally to the plane of the motion. At the same time the angular velocities tend to become equal to the velocities of revolution. Equally simple results may be deduced for the final motions of three bodies, and, indeed, for any number of bodies. The details of the calculations are not given in the paper. H. L. B.

133. New Formulæ for Special Perturbations. H. Roure. *Comptes Rendus*, 195. *pp.* 694–696, *Oct.* 24, 1932.—The position of the orbit is assumed to be defined by direction cosines; it is customary to return to the usual set of elements to compute the special perturbations. The author has put the equations in a form allowing the perturbations to be found from the direction cosines directly. T. L. M.

See also Abstract 125.

NEBULÆ.

See Abstracts 105, 106, 107, 108.

PLANETS.

134. Photographic Method of Recording the Angle of the Earth's Rotation by the Foucault Pendulum. Y. Okasaki. *Hiroshima Journ. Sci.*, 2. *pp.* 213–216, *Oct.*, 1932. *In English.*—A pendulum about 3 m. long with a bob of about 5 kg. and having an oscillation period of about 3·48 sec., was used. In the bob of the pendulum was a small electric lamp and a converging lens of very short focal length, the light passing out through a pin-hole. The method of lighting the lamp is shown and it is lit up at the start of the oscillation and at 10-minute intervals, a photographic record of the path being made. From the records of the Foucault angles an extrapolation to the angle at the start of the oscillation is made. This gives a limiting angle 0·00244 radians/min. against a theoretical value of 0·00247 radians/min. R. S. R.

See also Abstracts 129, 131, 132.

STARS.

135. Discovery and Observations of Stars of Class Be. Part II. P. W. Merrill, M. L. Humason and Cora G. Burwell. *Astrophys. J.* 76. *pp.* 156–183, *Oct.*, 1932.—A continuation of previous work [see Abstract 2654 (1925)]. The new data are given in five tables. Table I lists 138 stars found to have a bright Hα. Of these, 132 are of class B or closely related classes. Most of them are of magnitude 7, 8 or 9. Table II records the intensity of bright Hα and of the dark ultra-violet hydrogen lines estimated from objective-prism spectrograms. Table III gives observations with slit spectrographs of the yellow-red spectral region. Approximate intensities of bright Hα and of the dark (detached) D lines are indicated. Data from slit spectrograms of the blue-violet region are given in Table IV. The character and intensity of Hβ, Hγ and Hδ are tabulated, and miscellaneous information is included in the notes. Bright Hα and Hβ are especially intense in classes B0–B3 (Table V). The region of the double cluster in Perseus abounds in Be stars; a single objective-prism photograph showed 48, of which 27 were not previously known. Many faint Be stars appear reddish, an effect, possibly, of space absorption. AUTHORS.

136. Relation Between Total Velocity of Stars and Distance from the Galactic Plane. H. Mineur, Renée Canavaggia and Marie L. Fribourg. *Comptes Rendus*, 195. *pp.* 208–210, *July* 18, 1932.—The

galactic components of velocity of 1500 G, K and M giants are grouped by distance from the galactic plane. Mineur's results from radial velocities and Mohr's results [see Abstracts 3014 (1931) and 3660 (1932)] are included in weighted means, which appear to show some relationship; it is admitted that the scatter of individual values is too great for definite conclusions.
T. L. M.

137. Determination of Radial Velocities with the Hartmann Spectro-Comparator. H. Nöbel. *Zeits. f. Instrumentenk.* 52. *pp.* 453–460, *Oct.*, 1932.—Of all methods of measuring differential velocities, the comparison of two spectrograms with this instrument seems to be the best, both with regard to accuracy and to economy of time. Some systematic differences having been found in a series of measurements, a thorough investigation has been made at Leipzig Observatory with a new model furnished by Zeiss. The investigation is described in detail, and the result is established that velocities can be accurately measured to less than 1 km./sec., but the shifts obtained are greater at the red than at the violet end, and this as yet unexplained fact must be taken into account. In differential measures, the line of coincidence in star and comparison spectrum (Arcturus and iron were used) must always be the same for the whole series of spectra. In determining absolute velocities, the greatest possible length of spectrum must be measured, in order to cancel out this difference between red and violet.
M. A. E.

138. Coexistence of Stellar and Interstellar Calcium Lines in the Star H.D. 698. J. A. Pearce. *Roy. Astron. Soc., M.N.* 92. *pp.* 877–885, *Oct.*, 1932.—This star is the most massive binary yet discovered, the larger component being a star of mass 113·2 ⊙ and of spectral type B9*sek*, whilst the smaller is of mass 45 ⊙ and is of spectral type B5. The period is 56 days. The spectrum of the system provides for the first time an example of the existence of the fixed calcium line K, due to interstellar matter, in the spectrum of a star of spectral type later than B5.
G. C. McV.

139. Convection Zones in Stellar Interiors. L. Biermann. *Zeits. f. Astrophysik,* 5. 2. *pp.* 117–139, *Sept.* 30, 1932.—True heat conduction by free electrons is larger than had generally been assumed; in addition " spurious conduction " due to turbulence is so large, in many parts of a star, that it will determine the temperature-gradient. The amount of turbulence is investigated; the pressure is found to be still almost isotropic, and the temperature-gradient is always fairly near the adiabatic figure, differing most from it when the mass is large. Isolated convection-zones free from energy-sources are investigated in detail by numerical integration. The transport of energy tends to be periodic; in general, such oscillations will have no reason to be in phase throughout the star, but when the period agrees with the star's natural dynamic period a variable star may be expected to result. The point-source model is examined again from the new view-point. The mass in the stellar " nucleus " is found to be diminished. It appears certain that large nuclei cannot be fitted into stars, but small ones presumably may.
R. d'E. A.

140. Schwarzschild-Milne Model of the Outer Layers of a Star. Part II. E. Hopf. *Roy. Astron. Soc., M.N.* 92. *pp.* 863–868, *Oct.*, 1932.—A continuation of a previous paper [see Abstract 2122 (1930)]. It is known that the radiation-intensity, B, at optical depth τ is given by $B(\tau) = \frac{3}{4}F(\tau + \phi(\tau))$ where πF denotes the net flux. It is now proved that $0{\cdot}577 < \phi(\tau) < 0{\cdot}715$ for $0 \leq \tau < \infty$. G. C. McV.

141. White Dwarf Stars. E. A. Milne. *Nature*, 130. *pp.* 599–600, *Oct.* 22, 1932. *Abstract of Halley Lecture.*—The accuracy of the observational material from which the high density of these stars is deduced is reviewed and shown to be fairly high. The frequency of the white dwarf type of star in space is probably great as the central stars of planetary nebulæ and ex-Novæ are believed to belong to this class. The theory of the constitution of these stars is also dealt with. G. C. McV.

142. Minimum Masses of Seven Spectroscopic Binaries. J. A. Pearce. *Roy. Astron. Soc. Canada, J.* 36. *pp.* 345–348, *Oct.*, 1932.—The spectral types range from O7 to B8; their short periods, small eccentricities and large amplitudes are typical of early types. The masses of five are normal; that of type B8 is above the average for its class; that of O7 (29 Can Maj) is the third most massive known ($M \sin^3 i = 56{\cdot}5 \odot$). Interstellar Ca is characterised by narrow quality and stationary position; it is found in O7 (29 Can Maj) and in the three B3 stars. Stellar Ca is not seen in O7, is faintly seen in B3, moderately strong in B5 and prominent in B7–B8. A. S. D. M.

143. Statistical Properties of Cepheid Variables. Li Hen. *Comptes Rendus*, 195. *pp.* 601–603, *Oct.* 10, 1932.—An attempt to find indirectly the constant M_0 of the period-luminosity relation by finding the components of the solar motion relative to Cepheids; using the division into periods $<$ and $>$ 1 day, six values are found; weighted mean $M_0 = +0{\cdot}77$, reducing Shapley's distances by factor $0{\cdot}7$. Confirmation is sought from the resulting mean parallax. Velocity ellipsoids of the two classes are tabulated. The sun would be 166 parsecs N. of the galactic plane. T. L. M.

144. Light-Curves of Mira Stars of Spectral Class Me. H. Ludendorff. *Preuss. Akad. Wiss. Berlin, Ber.* 17–20. *pp.* 291–315, 1932. —A previous classification of these stars by means of the form of their light-curves has been revised and extended by using the much greater amount of material now available. A catalogue of 290 stars is given, showing their position, spectrum, period, maximum and minimum magnitude and type of light-curve, which is denoted by a symbol. These types are three, each with subdivisions: (1) steep rise to maximum and broad minimum; (2) essentially symmetrical; and (3) very marked pause on ascent, amounting sometimes to a double maximum. The periods range from 91 to 570 days, with a mean of 301 days. A discussion of the catalogue shows that stars with smooth curves have shorter periods than those with a hump, and that amplitude is correlated with period and curve-type. It has been found by others that for Mira stars in general the absolute brightness decreases with increasing period; but within each separate class of light-curve the apparent brightness increases with increasing period, and therefore probably the absolute brightness also. This, if confirmed, would bring the Mira stars into line with the δ-Cephei stars, and would thus support the view that variation in both cases is due to essentially the same cause. Stars of each curve-type also show spectra belonging to subdivisions of M which are later with increasing period. The curve-types do not show any special distribution with regard to galactic position, but it is remarkable that Mira stars of similar light-curves and periods are found near together on the celestial sphere much more often than can be accounted for by chance. M. A. E.

145. Mean Light-Curves of Long-Period Variables. Part VII. S. Boötis. A. A. Nijland. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 472–477, 1932. *In German.*—From 736 observations of this star in the years 1905 to 1931, a period of 273 days is deduced, with a maximum of $13^{\mathrm{m}}{\cdot}26$, and a minimum of $8^{\mathrm{m}}{\cdot}68$. A slight pause on the ascending curve occurred three times, and an abnormally bright minimum once, but these disappear completely in the mean curve, which is quite smooth, and closely resembles those of W Herculis and R Trianguli. [For Part VI see Abstract 3195 (1932).] M. A. E.

See also Abstracts 125, 127.

SUN.

146. Spectrum of the Solar Corona. T. L. de Bruin. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 286–294, 1932.—The discoveries of the various coronal lines in the earlier years are first reviewed and references are made to numerous explanations given by various authors of the characteristics of the corona. The author considers most of the lines of coronium can be explained by the action of neutral oxygen. From laboratory data a high precision in the calculation of coronal lines is not yet possible, but the red lines 6776, 6704 and 6374, and the green line 5303 can be connected with neutral oxygen. Several unidentified lines in the violet are considered to be possibly due to neutral nitrogen. R. S. R.

147. Hydrodynamical Interpretation of Solar Periodicity. D. Riabouchinsky. *Comptes Rendus,* 195. *pp.* 574–576, *Oct.* 3, 1932.—Report on experiments with a steadily rotating glass globe containing water and some air; a circulation is set up by more rapidly rotating vanes at the centre. It is found that instability is set up producing periodic turbulent motion. Reasons are given for believing that the ratio of the periodicity to the rotation period of the globe should be constant. The ratios are: models, 85; sun, 168. T. L. M.

148. Measurement of Solar Radiation. A. F. Dufton. *Journ. Sci. Instruments,* 9. *pp.* 319–322, *Oct.,* 1932.—An instrument for recording and integrating the intensity of solar radiation received on a spherical surface is described. A new criterion for sunshine is propounded and a comparison with Campbell–Stokes records is made. AUTHOR.

149. OH Band λ3064 and the Solar Spectrum. R. W. Shaw. *Astrophys. J.* 76. *pp.* 202–209, *Oct.,* 1932.—Precise measures of the wave-lengths of the high sequence members of the P and Q branches of the OH bands λ3064 and λ3122 have been made, and a study of the coincidences of these lines with weak lines of the sun as given in the *Revision of Rowland's Preliminary Table of Solar Wave-Lengths* has been carried out. Of the 102 lines listed, 50 can be identified in the sun with an average difference in wave-length of 0·010 Å. Of the remainder, only 19 have intensities, which would indicate that one might have expected to find them listed in *Rowland's Table.* The number of chance coincidences is 23. Sixty-three new assignments have been made to the branches of the OH bands λ3064 and λ3122. AUTHOR.

See also Abstracts 127, 154.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

150. Demonstration of the Geological Possibilities of Resistivity and Magnetic Prospecting Methods. C. A. Heiland. *Terr. Mag.* 37. *pp.* 343–350, *Sept.*, 1932.—Four surveys illustrating possible applications of the magnetic and resistivity methods are described. The magnetic surveys are applied indirectly to the location of gold and oil deposits by the anomaly due to the associated rocks. The possible sources of error in the interpretation of such surveys are discussed briefly. Magnetic survey over gold in place: The gold is associated with black shales containing bands of magnetite, which produce the anomaly. These are large, of the order of 500 γ, and this, together with geological considerations, tends to show that the present mine workings are in the gold reef itself. Magnetic survey for oil structures on the Nocona granite ridge: The anomaly is due to the deep-seated granite, but, from the contours of the bedrock, deductions are made concerning the structure of the overlying sedimentary layers. Good agreement is obtained between the lines of equal vertical magnetic intensity and the contours of the shallow formations. Resistivity survey for foundation problems: Measurements were directed to the location of a crushed zone in the granite bedrock. The position of the zone is given by low resistivity values due to the increased water content. Ground water resistivity work: The experimental resistivity curves for two areas are examined in the light of Hummel's theoretical curves, on which their interpretation is based. J. McG. B.

See also Abstract 392.

LAND, PHYSICS OF THE.

151. Stresses Near Surface of Cavity in Gravitating Solid. G. Nishimura and T. Takayama. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 723–766, *Sept.*, 1932. *In English.*—The problem of the stress distribution in the vicinity of a horizontal cylindrical cavity in a gravitating wedge-shaped solid, having its edge horizontal and its base and ends infinitely distant, is treated mathematically. This problem is related to the dynamical stability of a tunnel in a mountain, and is of interest in seismology, and in civil and mining engineering. In the first part of the paper, the equilibrium of a gravitating wedge-shaped solid of any apex angle is studied, as a preliminary to the development of particular formulæ for the stress distribution near a horizontal circular tunnel in such a solid, when its apex angle is a right angle. In the second part, tables and curves are given to relate the stress components to the quantities: a the radius of the tunnel, ϕ the inclination of one face of the wedge to the horizontal, and ξ, η the depth and lateral displacement, respectively, of the axis of the tunnel relative to the edge of the solid. The following results are summarized: (1) The maximum values of tension and compression, and their positions, vary with ϕ. (2) Variations of the ratios ξ/a and η/a have no effect on the variations of the positions of maximum and minimum stresses. (3) The sign of the stress may vary with the ratio η/a. (4) There are some positions on the surface of the cavity where the values of the stresses do not change as η/a varies. (5) The magnitude of the stress at a point on the surface of the cavity is proportional to ξ/a. (6) The rate of the linear increase of the stress with depth is different at different points on the surface of the hole. E. L. J.

METEOROLOGY.

152. Temperature of the Auroral Region Determined by the Rotational Series of the Negative Nitrogen Bands. L. Vegard. *Terr. Mag.* 37. *pp.* 389–398, *Sept.*, 1932.—Preliminary experiments are described which led to a quantitative determination of the temperature of the auroral region. These were based on the band 4278 of the negative nitrogen group, the R-branch of which, in the auroral spectrograms, had a sufficient photographic density to give intensity measurements. Using Aars' results at the temperatures of the room and liquid air, and using the position of maximum intensity, the temperature in the auroral region was found to be −29° C. From intensity distributions in the R-branch a mean temperature of −33° C. was derived. This mean temperature of −31° C. may increase with polar distance and vary with the season at any locality, while values derived from auroæ at sunrise and sunset may differ from those for midnight. The value conflicts with the high temperatures at these heights derived by Lindemann and Dobson to account for the appearance and distribution of meteors and the values derived by sound waves reflected in the upper air. The latter are criticised in that it is assumed that the equation for sound velocities, $V = V_0\sqrt{T/T_0}$, does not hold for low air densities. Experiments show that the sound intensity is practically zero below a pressure of 1 mm. Hg, the sound energy being absorbed or reflected. R. S. R.

153. Radiation in the Atmosphere. D. Brunt. *Roy. Meteorolog. Soc., J.* 58. *pp.* 389–418; *Disc.*, 418–420, *Oct.*, 1932.—The object of the paper was to estimate the net loss of heat by radiation from the ground at night. A curve is given which shows the coefficient of absorption of water vapour for wave-lengths from 0 to 34 μ, and is based on the experimental work of Hettner. Arguments are deduced to show that the absorption by water vapour, at least in the lowest atmospheric layers, may be obtained by direct use of the coefficients shown in this figure and deductions previously drawn from Eva v. Bahr's work are unjustifiable. The absorption spectrum of liquid water is shown graphically and the possibility of treating cloud and fog as black body radiators discussed. The downward radiation, R, from the atmosphere, the total black body radiation σT^4 at temperature T, and the vapour pressure, e, are related in the form $R = \sigma T^4(a + b\sqrt{e})$, where a and b are constants. This formula agrees closely with all available series of data, on the ground and at high levels, thus indicating that the net radiation from high ground is the same as from low ground under the same conditions of temperature and vapour pressure. The variation of surface temperature during the night, when radiation alone is considered, gives a parabolic thermograph curve from sunset to sunrise and a formula is derived which can be used to forecast the extreme minimum to which the temperature can fall during a calm night with clear skies. The radiation from the ground when the sky is overcast is shown to agree with the observed very small diurnal variation of temperature at the ground. The radiation from and absorption by cloud sheets are discussed, and the theoretical conclusions tested by comparison with the observations of Ångström and Asklöf. An explanation is given of the more frequent occurrence of clouds broken up into cloudlets or strips at middle and high rather than at low levels, and of ascending central motion in cloudlets by day. Radiation may cause the formation of inversions both at the top and below the base of a cloud sheet, the inversion at the top forming slightly more readily at night but that below the cloud being independent of the time of day. In the *Discussion* **Simpson** examined the application of the formula given above to dry air. **Keen** dealt with the application of the results to soils with different moisture content and the consequent change in minimum temperature. The author replied to these points. R. S. R.

154. Ultra-Violet Transmission Coefficient of the Earth's Atmosphere. R. S. Rockwood and R. A. Sawyer. *J.O.S.A.* 22. *pp.* 513–524, *Oct.*, 1932.—Thermocouple measurements have been made at four different altitudes in the neighbourhood of Albuquerque, New Mexico, of the intensity of solar radiation transmitted by a silver filter. These have been used to determine values of the transmission coefficient defined by $I = Ia^m$, where I and I_0 are respectively the observed and incident energies, a the transmission coefficient and m the air mass traversed in units of the vertical air path directly overhead at sea level and normal pressure. The results, corrected by the use of Hann's empirical equation for the effect of water in the path, gave for a at 3140 m., 0·47; at 2059 m., 0·47; at 1769 m., 0·46; and at 1556 m., 0·43. The last result, from observations on the New Mexico campus, is low probably because of dust scattering; the others are in agreement within the errors. The theoretical value calculated from Rayleigh's law of molecular scattering, and using a new value (λ3240) for the wave-length of maximum solar energy transmitted by a silver film, is 0·479. The conclusion is, that at least above 1700 m. altitude, and for clean dry air, the Rayleigh law for pure molecular scattering is adequate to account for the atmospheric depletion of solar radiation in the silver transmission band. The somewhat discordant results of earlier investigators are discussed. AUTHORS.

155. Origin of Anticyclones. C. E. P. Brooks. *Roy. Meteorolog. Soc., J.* 58. *pp.* 379–388, *Oct.*, 1932.—The author first reviews known facts regarding temperatures in the troposphere and stratosphere for the stable, slow-moving warm anticyclones and the fugitive, rapidly-moving cold anticyclones. The latter are considered to be definitely phenomena of the troposphere caused by an inflow of cold air from high latitudes. Cases of the former, examined in detail, show in the stratosphere an " island of cold air," limited to the south and tilted to the north-west from the centre of high pressure at the ground. The descending anticyclonic air current appears to be due to an accumulation of air above 9 km. which may be caused by (1) its low temperature and high density, *i.e.*, a fall of temperature in the stratosphere, or (2) the heaping up of air in the stratosphere or upper troposphere, the temperature fall being a secondary phenomenon. Mügge favoured (1), but objections to it are set out. Case (2) cannot be due to a broad drift of a cold southerly wind at high levels because of the existence to the south of the cold island of air. A possible explanation is given by the deflection of a broad, deep S.W. or N.E. air current in the upper troposphere raising the base of the stratosphere and cooling it. The air flow is at first too great for the pressure gradient, but later the inflow just balances the loss by subsidence. Reference is made to similar views advanced recently by Schmauss and Bjerknes. R. S. R.

156. Size of Fog Droplets. M. Kinoshita and K. Uchiyama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 144–147, *Oct.*, 1932. *In English.*—Photographs were taken of fog droplets and measured, the diameters varying from 1·5 to 10 μ. In the problem of the transmission of rays of light or heat through fog, not only the size of the fog droplets but also the space distribution of the droplets of different sizes is of great importance. The present work was begun as a preparation to studying the transparency of fog for infra-red rays. Its object was to obtain quantitative data in regard to the constituency of fog artificially produced. Among the many known methods of measuring the size of fog droplets, the only one that could be employed for the present purpose was to catch the droplets in large numbers and examine them under a microscope. A coverglass, over which a drop of oil was spread, was placed in a fog chamber. Fog droplets were driven into this oil film by a puff of air from a small syringe. The coverglass was then brought under a microscope to be examined and in some cases photographed. E. E. F. d'A.

157. Theory of the Vane Anemometer. B. G. van der H. Zijnen. *K. Akad. Amsterdam, Proc.* 35. 7. *pp.* 1004–1013, 1932.—Reference is made first to Ower's theoretical relations regarding (1) the angle at which the vanes are to be set in order that the instrument shall commence to rotate at the lowest possible wind-speed, and (2) the internal friction of the mechanism. These are considered to be too much simplified to be reliable in the general case. The author obtains expressions for the total axial and tangential forces acting on the blade, the latter depending upon the internal friction of the mechanism. The blade angle at which a given instrument commences to rotate at the lowest possible wind speed is found and for the type of vane considered has, in general, a value of 40°. This value is confirmed by Ower's experiments. The magnitudes of the disturbing components in the initial stage of the motion are considerable in the usual type of instrument and these are found for a Fuess type of instrument where the calibration curve is known. Finally, the internal friction is calculated. R. S. R.

See also Abstracts 78, 251, 313.

SEISMOLOGY.

158. Seismic Scale and Maximum Acceleration. M. Ishimoto. *Tokyo Univ. Earthquake Research Inst., Bull.* 10. *pp.* 614–626, *Sept.*, 1932. *In French.*—The intensity on the Japanese Central Observatory Scale (for which a table is given correlating it with the International Scale) of 86 earthquakes as observed by a trained observer is plotted against the maximum horizontal acceleration as recorded by the author's accelerometric seismometer [see Abstract 355 (1932)] at the Tokyo Earthquake Institute, the period of seismic waves there being 0·3 sec. and that of the seismometer 0·15 sec. Taking as the acceleration of the earthquake the average of those horizontal waves as recorded (*i.e.*, without compounding) which show greatest acceleration, the acceleration as recorded in gals. increases logarithmically as the scale number increases arithmetically, the figures being for Scale No. I, 0·5–2 gals.; Scale No. II, 2–8; Scale No. III, 8–32; Scale No. IV, 32–128; Scale No. V, 128–512; Scale No. VI, > 512. This correlation will probably not be valid at a place where the period differs from 0·3 sec. Results agree well with Omori's scale. Accelerations deduced from records of ordinary seismometers are quite unreliable for the present purpose. C. A. S.

See also Abstract 151.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

159. Potential Gradient and the Air-Earth Current. F. J. W. Whipple. *Terr. Mag.* 37. *pp.* 355–359, *Sept.*, 1932.—The apparatus in use at Kew to determine the air-earth current is described. A numerical theory is developed assuming uniform turbulence and uniform conductivity which helps in deciding that the effective conductivity at the ground is λ_1, and that at a considerable height is $(\lambda_1 + \lambda_2)$, where λ_1 and λ_2 are the conductivities for positive and negative electricity, respectively. The electrode effect is found to be appreciable up to a height of 100 m. The respective potential gradients at 30, 60 and 120 m. are compared with those at the ground, and the Kew observations appear to support the view at the lowest levels. Measurements are required of the potential gradient and conductivity in the lowest 100 m. and it is suggested that the kite may be of use in this connection. R. S. R.

160. Polarity of Thunderclouds. E. C. Halliday. *Roy. Soc., Proc.* 138. *pp.* 205–229, *Oct.* 1, 1932.—Arrangements were made whereby the sudden change of electric field caused by a lightning flash [see Abstract 1677 (1928)] was recorded as often as possible synchronously with visual observation of the character of the flash, and a photograph thereof. Of 3105 flashes observed at Johannesburg between 14th Oct., 1928, and 8th Dec., 1930, 1392 caused a positive and 1623 a negative change of field; of these, 560 were visually observed, including 277 cloud flashes and 283 ground flashes, of which respectively 106 and 267 caused a positive and 171 and 16 a negative change of field. The changes are discussed in relation to distance, etc., of flashes, and shown to support the view that the upper charge of a thundercloud is positive and the lower negative. By aid of the photographs the nature of double flashes and their effects on the field are dealt with, and it is shown that negative electricity can travel from cloud to ground by a flash that branches toward the ground. C. A. S.

161. Atmospheric Parasites. F. Link. *Comptes Rendus,* 195. *pp.* 619–621, *Oct.* 10, 1932.—Atmospheric parasites recorded between Nov., 1931, and Aug., 1932, at the Pic-du-Midi Observatory (2860 m.) from 3 hours before to 1 hour after sunrise show marked maxima when the sun is about 5·8° and 11°, and a smaller one when 15·6° below the horizon, the corresponding altitudes being 35, 115 and 235 km., or the approximate positions of the ozone maximum, Heaviside layer and reflecting layer as found by echo, respectively. [See also Abstract 578 (1931).] C. A. S.

162. Secular Variation of Earth's Magnetism. A. Schmidt. *Terr. Mag.* 37. *pp.* 225–230, *Sept.*, 1932. *In German.*—In this paper the author reviews the work of L. A. Bauer in the field of secular variation, with particular reference to the evidence it provides of the periodicity in the magnitude of the magnetic moment and in the description of the vector diagram. Schmidt then analyses the hypothesis, which Bauer's work suggests, that the earth's magnetism can be explained on the assumption of a magnetic earth-core, the magnetisation of which is on the whole regular but subject to slight regional variations, and which rotates slowly about an axis fixed in the earth. The author shows that the evidence is especially consistent with the particular hypothesis that the axis of rotation of the core is somewhere midway between London and Capetown, and the path of the secular poles, the points at which the core intersects the surface, approximates to the 90°–270° meridian. Schmidt concludes by stressing that the evidence is, however, very scanty, and that much more is required before this hypothesis can be satisfactorily checked. E. L. J.

163. Secular Change of Earth's Magnetism. D. L. Hazard. *Terr. Mag.* 37. *pp.* 231–234, *Sept.*, 1932.—A brief history of the observations of variation of the earth's magnetic field is given, leading to the modern practice of measuring variations at a series of stations at intervals of a few years, and thereby computing the annual change at each station. Isopors, or lines of equal annual variation, are drawn and, as shown by Fisk, a study of the change in relative position of the isopors brings out important relationships. Further data and study are needed, particularly in connection with sea areas. E. L. J.

164. Unsymmetrical Distribution of Secular Variation. H. W. Fisk. *Terr. Mag.* 37. *pp.* 235–240, *Sept.*, 1932.—A review of recent observations of the annual change of the magnetic elements over the earth shows that localities of relatively intense activity can be traced. A study of the change of the horizontal intensity, in particular the values $\Delta H/H$, demonstrates that the variations are irregular, and that negative values of ΔH preponderate over positive. The supposition that these areas of intense activity are related to the distribution of land and water is considered, and to some extent confirmed. The conclusion is drawn that, superposed upon the more regular variation in the magnetic elements, presumably connected with movements of the magnetic axis or changes in the earth's magnetic moment, there are irregular regional changes which may arise from geological causes. These latter are concentrated in a few active regions, and intensive research at these regions is desirable. Information bearing on the fundamental problem of the constitution of the earth's interior may indirectly be obtained from such research. E. L. J.

165. Variations of Earth's Magnetic Elements near Poles. B. P. Weinberg. *Terr. Mag.* 37. *pp.* 241–244, *Sept.*, 1932.—The distribution of magnetic isolines and isopors in the vicinity of the earth's magnetic poles is obscure on account of paucity of observations. From a theoretical investigation of the potential of a magnet, in the region of its poles, the formulæ for the various elements Z, H, I can be obtained in terms of Z_0, the value at the pole, and ψ, the magnetic latitude at an adjacent point. Comparison with charted values shows that, apart from a striking non-coincidence of the distribution of Z, and the resulting asymmetry of the distribution of H and I, the general picture of the distribution of H and I, and of their spatial derivatives, is fairly congruent with the observations. The formulæ for the time derivatives $Z' = dZ/dt$, $H' = dH/dt$ and $I' = dI/dt$ are derived in terms of Z_0, ψ, v, the velocity of the motion of the pole, A and A_k, the azimuths of the motion of the pole and the point K relative to the pole. Figures of the distribution of these derivatives round the pole are drawn, and should assist in constructing isoporic charts of H and I for the polar regions. E. L. J.

166. Field Energy of Magnetic Storms. S. Chapman. *Terr. Mag.* 37. *pp.* 269–272, *Sept.*, 1932.—The magnetic storm is regarded as produced by current flowing round an equatorial ring westwards on a radius of 20,000 to 30,000 km. The excess energy of the field during a storm is calculated in two parts, S the self-energy of the disturbing field, and J the joint energy due to the combined presence of the above field and that of the earth. S is reckoned to be of the order J/8, and the field energy of a standard (100γ) magnetic storm is about 5×10^{22} ergs, and forms a small fraction of the kinetic energy of the neutral stream of corpuscles. [See also Abstract 4500 (1932).] G. E. A.

167. Sudden Changes in the Earth's Magnetic Field. L. Rodés. *Terr. Mag.* 37. *pp.* 273–277, *Sept.*, 1932. *In Spanish.*—The frequency of sudden changes in the earth's magnetic field is examined in a large collection of data of the Ebro Observatory. Sudden changes in intensity of the components depend on solar activity, and are obedient to extra-planetary causes. The curve of annual frequencies shows definite maxima which correspond to the dates of the equinoxes. The curve of daily frequencies shows that abrupt changes, which have a purely local range, are related to the direction in which the local meridian is moving with respect to the orbital motion of the earth. [See Abstract 4500 (1932).] W. A. R.

168. Terrestrial Magnetism. A. Nippoldt. *Terr. Mag.* 37. *pp.* 279–286, *Sept.*, 1932. *In German.*—Bauer's "local geomagnetic constant" is used to study the geographical distribution of magnetism. The distribution of geomagnetic constants is parallel to Bauer's residual field. Secular variation concerns not only the quasi-homogeneous field, but also the residual. The regional perturbation of the residual field, especially the European area, is greater than that for the whole earth. W. A. R.

169. Magnetic Potential at the Geographic Pole. L. Steiner. *Terr. Mag.* 37. *pp.* 287–289, *Sept.*, 1932.—It is shown that the magnetic potential of the permanent field at the geographic pole can be calculated if the values of the component towards the geographic N-pole of the magnetic force for all points of the earth's surface are known, provided that the source of the permanent field lies entirely within the earth's crust. If there are also agents without the earth's crust, one constant value—the potential of the exterior source in the centre of the earth—remains undetermined. W. A. R.

170. Auroral Curtains and the Corpuscular Theory. C. Störmer. *Terr. Mag.* 37. *pp.* 375–388, *Sept.*, 1932.—The differential equations for orbits of electrons in the field of a magnetic dipole are set out, and from these a series of orbits has been calculated which pass through the dipole and extend to infinity. The results are shown diagrammatically for a series of these orbits. These results are then applied to the corpuscular theory of auroræ where the earth's magnetism is considered equivalent to that of a dipole and where each electron is supposed to move independently of the others. From among the numerous electron trajectories towards the earth, terrestrial magnetism will filter out a very small number, consisting of those in the immediate vicinity of the trajectories through the origin, and from these a line of precipitation into the earth's atmosphere will result and be seen as a horseshoe-shaped curtain. [See Abstract 1325 (1932).] R. S. R.

See also Abstract 213.

RADIOACTIVITY.

171. Ionising Power of Artificial H-Rays. K. Diebner. *Zeits. f. Physik*, 77. 9–10. *pp.* 581–600, *Aug.* 24, 1932.—The measurements of Diebner and Pose on Al and of Pose on F are examined in relation to the ionising power of the protons produced, and the differential ionisation in dependence on the range is investigated. It is shown that the ionisation constants for H-rays and α-rays are within the limits of error in the ratio 1 : 4. J. J. S.

172. Ionisation of Solid Paraffin by α-Rays. Hermine Folmer. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 636–642, 1932.—A thin plate of solid paraffin, 0·2 mm. thick, was placed between the electrodes of an electric field, one electrode being at +80 volts. After some time it was exposed to the radiation of a plate of polonium. The current through the paraffin was observed for several hours after each exposure. To eliminate a possible deposition of RaD or RaR on the paraffin, aluminium foil was introduced between the polonium and paraffin in certain of the experiments. The results show that the polonium has some effect in causing the ionisation of the solid dielectric, though the author makes a reservation with regard to the deposition of α-particles on the surface of the paraffin. E. E. F. d'A.

173. Multiple Scattering of α-Rays Passing Through Thin Metal Foils. G. Maurer. *Zeits. f. Physik*, 78. 5–6. *pp.* 395–411, *Oct.* 4, 1932.—Using the proportional point counter, the multiple scattering of α-particles passing through thin metal foils is investigated and found to be in agreement with previous results obtained by use of the scintillation method. The velocities of the α-particles range from $2{\cdot}04 \times 10^9$ cm./sec. to $0{\cdot}88 \times 10^9$ cm./sec., and the most probable angle of scattering is found to be (1) inversely proportional to the square of the velocity, and (2) proportional to the square root of the thickness of the foil from 10^{-5} to 10^{-4} cm. Measurements on Al, Ag and Au show considerable departure from proportionality to atomic number; this is attributed to screening of the nucleus by the extranuclear electrons. Taken as a whole, the results agree with Bothe's theory, but a small correction is made to the formula to account more completely for the electron screening of the nucleus. F. C. C.

174. Passage of Hard β-Rays through Matter. C. Moller. *Ann. d. Physik*, 14. 5. *pp.* 531–585, *Aug.* 15, 1932.—A mathematical discussion of the passage of hard β-rays through matter in agreement with the quantum and relativity theories. J. J. S.

175. Energy Distribution Curves of Disintegration Electrons. B. W. Sargent. *Cambridge Phil. Soc., Proc.* 28. *pp.* 538–553, *Oct.*, 1932.—The author discusses a method which he has adopted for determining the shape of the distribution curve for disintegration electrons. Knowing the distribution curve, it is shown that it is possible to calculate the shape of the absorption curve, and the method is applied with success to several cases in which both curves are known. By a process of trial and error

it is thus possible to determine the distribution curve which will produce a given absorption curve, and this process is applied to the cases of actinium C″, uranium X_2, thorium C′ and thorium C. It appears probable that the distribution curves for the β-rays for all elements have the same shape.
J. E. R. C.

176. γ-Radiation. A. Bramley. *Nat. Acad. Sci., Proc.* 18. *pp.* 543–550, *Aug.*, 1932.—A theoretical paper which considers the wave-equation in connection with the mechanism of nuclear absorption of very hard γ-rays. An approximate calculation of the internal absorption coefficient for γ-rays is made by statistical methods. W. E. P.

177. Absorption and Scattering of Hard γ-Rays. C. Y. Chao. *Tsing Hua Univ., Sci. Reports,* 1. *pp.* 159–176, *July*, 1932. *In English.*—The paper is in two sections. The first describes the experimental determination of the absorption coefficient of hard γ-rays from ThC″ for H_2O, Al, Cu, Zn, Sn and Pb. For elements of higher atomic numbers an additional absorption other than that predicted by the Klein-Nishina formula exists. The second section describes experiments for the measurement of the scattering of Al and Pb. In the case of Pb, corresponding to the additional absorption, there is an anomalous scattering which is accompanied by a characteristic change in wave-length different from that of ordinary Compton scattering. The results indicate interaction between the radiation and the nucleus. W. E. P.

178. Calculation of Scattering Correction of γ-Rays. G. T. P. Tarrant. *Cambridge Phil. Soc., Proc.* 28. *pp.* 475–489, *Oct.*, 1932.—The method of applying the scattering correction in accurate γ-ray absorption measurements is discussed, and it is shown that the scattering correction only diminishes, as the solid angle subtended by the chamber at the source is reduced, if the absorber diameter is reduced correspondingly. The method of calculation of the scattering correction in cases in which the absorber is placed very close to the chamber is explained; and the result of the calculation for one particular chamber is shown to be in satisfactory agreement with the experimental values. The scattering correction allows the ionisation function of chambers to be determined, and an (ionisation function)/(wave-length) curve is shown for a steel thick-walled high-pressure ionisation chamber. E. E. F. d'A.

179. Multiply-Charged Particles of Mass One. M. Delbrück. *Nature,* 130. *pp.* 626–627, *Oct.* 22, 1932.—Nuclear electrons are in many ways incapable of ordinary dynamical treatment. The binding energy per nuclear proton is normally about 1000 times as great as would be expected by assuming Coulombian forces. Another discrepancy arises in the anomalous scattering of hard γ-radiation, and again the predicted values are about 1000 times smaller than those observed. To explain these facts the author advances the hypothesis that the particles of mass one may have arbitrary, positive or negative (but perhaps only integral) values of its charge. In particular, a free particle may have charges e or 0 and an α-particle $+6e$ or $-5e$. It is suggested that the existence of such particles, besides explaining the large nuclear forces and the strong anomalous γ-ray scattering, would also explain various phenomena associated with cosmic radiation. J. E. R. C.

RADIATION.

ABSORPTION AND TRANSMISSION.

180. Photoanisotropic Effects in Dyes. T. Kondo. *Zeits. f. wiss. Phot.* 31. *pp.* 153–167, *Oct.*, 1932.—1700 normal dyes in gelatin and collodion layers were examined for the Weigert effect. The dyed layers mounted on glass plates were illuminated for 20 to 50 min. by polarised sunlight, the polarisation being produced by a heliostat set at the polarisation angle, and then examined for dichroitic and double refraction effects. Of the 1700 dyes tested, only 450 definitely showed the Weigert effect, a few more being partially affected. No general relationship between the dyes giving the effect and the type of layer used was found, although more dyes showed the effect when used with gelatin. Most of the 450 dyes are found to be red, red-brown, brown, rose, orange or yellow dyes, green, blue and violet dyes giving no signs of the Weigert effect. Thus there appears to be a connection between the Weigert effect and the absorption spectrum. Generally, dyes with the absorption maxima between 7000 and 5400 Å. showed no effect, those between 5200 and 5000 Å. showed the dichroism due to the Weigert effect, whilst the dyes with absorption maxima from the green to the violet end of the spectrum showed marked double refraction as well as dichroism. The Weigert effect for dyes used with gelatin layers is unstable, in that it is sensitive to moisture, a slight moistening being sufficient to restore the original isotropic condition. It is also a reversible process. R. C. F.

See also Abstracts 209, 293.

COLORIMETRY.

181. Colour of Silver as a Function of its Surface Condition. A. Kutzelnigg. *Kolloid Zeits.* 61. *pp.* 48–50, *Oct.*, 1932.—The author collects together published observations on the colour of silver prepared and treated in various ways. White light after repeated reflections at polished silver surfaces acquires a yellow colour. For this reason coarse crystalline silver powder appears yellowish grey. Loose, porous preparations of silver vary in colour from white to dark brown, depending on the porosity. In every case, however, silver preparations in white light exhibit a yellow colour component. W. S. S.

See also Abstract 197.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

182. Magneto-Optic Rotation by Condenser Discharge. F. G. Slack and W. M. Breazeale. *Phys. Rev.* 42. *pp.* 305–311, *Oct.* 15, 1932.—The rotation of the plane of polarisation of light produced by a condenser discharge across a spark gap has been measured when the condenser discharges through a coil surrounding various media of comparatively high Verdet constants. The set-up is similar to that used by Allison, except that a Lippich double field polarimeter replaces the crossed nicols. The rotations have also been computed from the constants of the circuit, and curves show the agreement between calculated and experimental rotations to be good. Conclusions are drawn in regard to the relation of these measurements to the experiments of Allison. [See Abstract 2285 (1932).] AUTHORS.

INTERFERENCE. DIFFRACTION AND SCATTERING.

183. Scattering Processes of Higher Order. P. Güttinger. *Helv. Phys. Acta,* 5. *pp.* 237–261, *Sept.,* 1932. *In German.*—Processes in which two light quanta, $h\nu_1$ and $h\nu_2$, disappear and a scattered light quantum $h\nu_3$ arises are treated by quantum mechanics. It is shown that in the great majority of cases those processes occur in which $\nu_3 = \nu_1 + \nu_2 \pm \nu_{m,k}$, where $\nu_{m,k}$ corresponds to an atomic frequency. An estimate of the order of magnitude involved shows that the processes considered must be observable if sufficiently intense sources of light are available. A comparison with the probability of the Raman effect shows that the probabilities are in the ratio: $W/W_{\text{Raman}} \sim \mathbf{S} \times 10^{18}/(\Delta\nu)^2$, where $\Delta\nu$ has the order of magnitude of a resonance denominator, and $\mathbf{S}$ denotes the density of radiation. Other related questions are discussed in detail. H. L. B.

184. Scattering of Light. W. D. Bancroft and C. Gurchot. *J. Phys. Chem.* 36. *pp.* 2575–2587, *Oct.,* 1932.—Attention is drawn to serious discrepancies existing between Rayleigh's equation for the selective scattering of light by small particles and the actual colours that can be observed under suitable experimental conditions. Methods of preparing finely divided suspensions of several substances are described; in many cases the relation between the sizes of the particles and the colours they produce cannot be adequately explained by Rayleigh's equation. In particular, the colour changes are shown to be periodic, in a manner closely analogous to colours produced by interference in thin films, and Rayleigh's equation is only sufficient to explain the variations over part of the observed range. No alternative theory is put forward. W. D. W.

185. Light Scattering in Supercooled Benzophenone. W. T. Richards and P. M. Harris. *Am. Chem. Soc., J.* 54. *pp.* 3799–3810, *Oct.,* 1932.—The light scattered laterally by a column of liquid has been measured at various temperatures by recording it photographically, using a modified form of the apparatus devised by Wood for Raman spectra. CCl_4 follows the form of equation given by Einstein and by v. Smoluchowski, but supercooled benzophenone does not. For this liquid, the scattering increases with decreasing temperature, where theory predicts the opposite effect. It is suggested that some form of molecular aggregation must take place, and it is noted that it must differ in some important respect from the stable crystalline lattice. Incidentally to the main investigation it is pointed out that the quantity $\frac{v}{\beta}\left(\frac{\partial\beta}{\partial T}\right)_p \Big/ \left(\frac{\partial v}{\partial T}\right)_p$ has a value not far from 70 for a large number of liquids. Here β is the compressibility, v the specific volume, p the pressure and T the temperature. J. H. A.

See also Abstract 79.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

186. Photochemical Decomposition of Nitrous Oxide Sensitised by Mercury Vapour. W. M. Manning and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 54. *pp.* 3907–3917, *Oct.,* 1932.—From a study of the changes of total pressure, and pressure of gas uncondensed by liquid air as a function of the time, the total reaction between excited Hg and N_2O is represented by the equation $Hg + N_2O = HgO + N_2$. Possible primary steps of the reaction are discussed, and some indications are obtained from the pressure variations when NO or O_2 is added to the N_2O. Reaction rate experiments indicate that the effective cross-section of the N_2O molecule as regards its interaction with excited Hg is very large. N. M. B.

187. Decomposition of Hydrogen Molecules by Impact with Excited Xenon Atoms. H. R. Calvert. *Zeits. f. Physik,* 78. 7–8. *pp.* 479–485, *Oct.* 12, 1932.—Conclusive proof of a chemical reaction being caused by impact of an excited atom which takes no other part in the process has hitherto been lacking. Irradiation of a mixture of H_2 and Xe with the Xe line of wave-length 1469 Å. (all shorter wave-length radiation being excluded by using a fluorspar window) causes dissociation of the H_2 molecules, as evidenced by the reducing action of the mixture on tungsten trioxide. Measurement of the pressure change resulting from adsorption of the H atoms on the walls of the vessel indicates that at a hydrogen pressure of 2·5 mm. one H_2 molecule decomposes per sec. in presence of 6400 Xe atoms. H. F. G.

188. Oxidation of Solutions of Iodoform. René Dubrisay and G. Emschwiller. *Comptes Rendus,* 195. *pp.* 660–662, *Oct.* 17, 1932.—The oxidation in air of iodoform in benzene solution kept in darkness is shown to occur on addition of I and HI, neither of which alone has any effect. These two substances are shown to be the photodecomposition products of the solution. HCl can take the place of HI. The oxidation only occurs in certain solvents. It is also inhibited by impurities. A. S. C. L.

189. Photo-Bromination of Benzene. E. Rabinowitsch. *Zeits. f. phys. Chem.* 19. *Abt.B.* 2–3. *pp.* 190–202, *Oct.*, 1932.—A monochromator is described which allows of the study of the effect on a photochemical process of alteration of the wave-length of the light in steps of 500 $cm.^{-1}$. In the photo-bromination of benzene, the quantum yield at room-temperature amounts to 0·3–0·8, and is dependent on the concentration of the bromine, the intensity of the light and, particularly, the temperature; it is independent of the wave-length in the region 3000–5500 Å., but appears to decrease at higher wave-lengths. The mechanism of the bromination in the dark and in the light is discussed. Even when the benzene is greatly diluted with CCl_4, the bromine molecules hold on to benzene molecules, and, in applying the law of mass action to photochemical reactions in such highly solvated systems, care must be taken that the atoms arising by adsorption must be in contact with a reactive molecule immediately after they appear. It is suggested that the formation of the addition product $C_6H_6Br_6$ mainly results from reaction immediately following absorption, and that the substitution product is formed after separation of the bromine into free atoms. The substitution reaction $C_6H_6 + Br = C_6H_5 + HBr$, followed by $C_6H_5 + Br_2 = C_6H_5Br + Br$, requires thermal activation, and conditions the high temperature coefficient of the photochemical reaction. T. H. P.

190. Sensitisation by Auxiliary Exposure. W. Hartree and A. V. Hill. *Journ. Sci. Instruments,* 9. *pp.* 329–330, *Oct.*, 1932.—A description of phenomena observed when bromide paper, on which a galvanometer trace has been made, is left exposed to diffuse light. Intensification takes place, and a distinct increase of blackening is found with an exposure of 1 min. to the diffuse illumination; the illumination is such that the effect reaches its maximum in about 6 min., after which the paper as a whole commences to blacken. A. H.

191. Thallium in Silver Bromide. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 31. *pp.* 168–171, *Oct.*, 1932.—The results of a comparison between a silver bromide solution which is free from thallium and one which contains a quantity of thallium, such that it is about 4 % of the silver salt, show several remarkable facts. Before ripening, the thallium-containing plate shows an extraordinary tendency towards solarisation compared with the other plate, but after successive stages of after-ripening the sensitivity of the thallium plate is always lower than that of the other plate. The rapid increase of sensitivity with after-ripening which is obtained with the thallium-free plate results in an earlier occurrence of fog than occurs with the thallium plate, the latter plate being much clearer after 1½ hours after-ripening than the former after only ½ hour after-ripening. The action of capri blue on unripened plates illustrates a desensitisation action with the thallium plate when compared with the effect of the same dye on the thallium-free plate. The peculiarities exhibited by the thallium plate do not appear if lead is substituted for thallium. R. C. F.

192. Unexplained Fog Formation. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 31. *pp.* 172–178, *Oct.* 1932.—Plates desensitised in phenosafranin to which manganese sulphate solution has been added will always be found to be badly fogged when neol is used as the developer. Other desensitisers are found to give rise to the same fogging, but with isochinolin red and rhodamin B fogging is not produced. Neol is the only developer in which this action takes place, but a similar quantitative effect is obtained with ferrous sulphate and hydroquinone as the developer. This fogging is not confined to hydroquinone, for it also appears to a higher or less degree with other developers among which is neol. Isochinolin red is found among the desensitisers which give rise to the fog when mixed with ferrous sulphate, but rhodamin B again has no effect. Fogging is also produced if the developer contains mercuric silver cyanide, and not only occurs with normal plates but also with silver bromide-collodion emulsions and silver iodide gelatin plates. The cyanide must be mixed with the developer, for no fogging action occurs if the plate is first washed with cyanide solution and then developed in a simple developer. This fogging action of the developer containing cyanide disappears if the solution is allowed to stand for some 6–7 days before use. R. C. F.

193. Effect of Intensity and Underlying Fogs on the Latent Image. F. E. Poindexter and L. E. James. *J.O.S.A.* 22. *pp.* 525–536, *Oct.*, 1932.—The reciprocity failure of fast plates is examined, and is found to be greatest for low intensities. It is also observed that when two exposures are superposed the order of exposing can affect the final density; thus a white radiation of low intensity is more efficient when placed on the latent image of a strong light than when the order of exposure for the two lights is reversed. The results are held to support a crystal-shattering hypothesis of latent-image formation which is discussed at length. A. H.

194. Slow-Motion Photography in the Service of Technical Physics. W. v. Ohnesorge. *Zeits. f. techn. Physik,* 13. 7. *pp.* 299–302, *and* 13. 8. *pp.* 345–350, 1932.—To regulate the time of exposure in producing high-speed kinematographic records either an electric spark or a mechanical shutter may be used. In the latter case the motion of the image must be allowed for optically. The quality of the photographic record depends in either case on the ratio of the time of exposure to the rate at which the images succeed one another. If a rotating shutter is used the error of definition in the image, namely, the lack of sharpness and distortion due to the motion of the body and of the film, is directly proportional to the characteristic figure given by the above ratio. In Thun's apparatus " optical compensation " is achieved by interposing in the ray path of the objective a shutter device which moves the picture of the moving object along synchronously with the moving film, so that the only errors involved are those arising from the motion of the object, but not from the motion of the film. But since the lens which effects the compensation moves in a circle, whereas the film passes on in a straight line, there is an error (due to the difference of length between the arc and the chord), which can, however, be kept within practical limits. There is also a third method of slow-motion photography in which a group of pictures is thrown on to the film by a complex set of lenses. The error corresponds with that which occurs in the preceding process. To obtain time markings a tuning-fork generator may be used, whose vibrations are recorded on the edge of the film by means of a highly actinic glow lamp. H. L. B.

195. Kinematography with High Picture Frequency. W. Ende. *Zeits. f. techn. Physik,* 13. 10. *pp.* 483–487, 1932.—A table gives for the various forms of apparatus the movement of the film, the method of illumination and the number of pictures obtained per sec. The former known kinematographic procedure for the attainment of high picture frequency is outlined, and the possibility of increasing the rate of reception is mentioned. An existing optical arrangement of prism strips and the associated source of illumination are described. The normal picture base is subdivided into a form of chessboard with a picture obtained successively on each segment as it is illuminated. By this means the rate of reception can be raised to 80,000 pictures per sec. The usefulness of the procedure is shown by many examples. R. S. R.

196. Effect of Variables in Sensitisation of Photographic Emulsions by Dyes. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research,* 9. *pp.* 529–545, *Oct.,* 1932.—The experiments now described were designed to test the effect of independent variables in the emulsion on the relative spectral sensitisation by a given dye in a given emulsion. Four typical dyes representing four series were used in combination with emulsions of different types. Relative spectral sensitivity increased slowly with the concentration of dye. In agreement with Sheppard, it was found that the relative spectral sensitivity was little affected by the formation of sensitivity nuclei (*e.g.*, from allyl thio-carbamide) which greatly increased the absolute sensitivity to any wave-length. Alkalinity increased relative spectral sensitivity by an extent which depended on the dye. Increased silver-ion concentration generally increases sensitisation by any dye, but there are differences between individual dyes which may be explained on the hypothesis that spectral sensitisation depends on adsorption of the ion of the dye by the oppositely charged ion of the silver halide lattice; changes in adsorption of basic dyes may be sufficient to counteract the general trend at sufficient excess of silver. H. H. Ho.

See also Abstracts **94, 260, 287, 301, 338.**

PHOTOMETRY.

197. Heterochromatic Measurements with the Pulfrich Photometer. E. Mayer. *Phys. Zeits.* **33.** *pp.* 665–670, *Sept.* 1, 1932.—The paper describes the determination of the " absolute brightnesses " (baryta white = 100) of the samples forming colour circle *nc* in Ostwald's colour atlas, with the aid of Pulfrich's step-photometer. Two methods were used: (1) the step method in which the brightnesses of adjacent samples in the colour circle are compared, and (2) a method in which pairs of samples of complementary colours are selected and the brightness of a grey mixture in known proportions of each pair is determined, together with the ratio of the brightnesses of the components, by direct heterochromatic photometry. The two methods gave results in good general agreement, although a small systematic difference was observed. A detailed comparison is made with earlier measurements by Kohlrausch and Gibsone using other copies of the colour atlas. The considerably higher values of the absolute brightnesses obtained by these earlier workers are attributed to errors in their methods. W. S. S.

198. Slide Rule for use with a Polarisation Photometer. M. Richter. *Zeits. f. techn. Physik,* **13.** 10. *pp.* 493–494, 1932.—Describes a slide rule by means of which it is possible to read off at once the ratio $\tan^2\phi_1/\tan^2\phi_0$ needed when determining transmission ratios with a polarisation photometer. All values of ϕ_1 between 3° and 87° are covered. The density (*i.e.*, the positive value of the logarithm of the above ratio) can also be found by a simple manipulation of the rule. J. W. T. W.

199. Photoelectric Photometry. P. R. Gleason. *Rev. Sci. Instruments,* **3.** *pp.* 556–560, *Oct.*, 1932.—The sensitive surfaces of two Weston Photronic cells have been combined into a single photometer cell such that a simple null method of photometry is available. The sensitivity of the device has been studied when a sensitive galvanometer was used as indicator and found to be about five times that of visual methods. Immediate application to the comparison of two similar sources is possible; and by incorporating windows of the filter material recently described by O'Brien, comparison of the luminosity of any two sources is possible without recourse to a flicker photometer. E. E. F. d'A.

200. Photoelectric Photometry and Spectrophotometry. P. Fleury. *Rev. d'Optique,* **11.** *pp.* 385–398, *Oct.*, 1932.—Describes a method of using photoelectric cells for precise photometry. Apart from difficulties due to non-linearity of response, dark-current, fatigue and colour sensitivity characteristics, there is also the difficulty that all portions of the kathode are not equally sensitive. It follows that in using the inverse-square law, the movement of the light source may cause different areas of kathode to be illuminated and so may introduce unsuspected errors. The author proposes to overcome this defect by causing the light from the lamp to fall upon a diaphragm with a sharply defined aperture. A lens is used to focus the edge of this aperture on the photoelectric cell, and in this way the area of kathode illuminated is kept constant, the inverse-square law being applied to distances measured from the lamp to the diaphragm. The cell used is one of high sensitivity (vacuum type), giving about 20 μA per lumen (gasfilled lamp colour). This cell is put in series with a resistance of the order of 10^9 ohms and measurements are made by balancing potentials across this resistance, using as detector a Lindemann electrometer. By this means measurements can be made to an accuracy of 0·1 % on luminous flux as low as 10^{-4} lumen, identity of colour being assumed. For spectrophotometric work, comparisons can be made for spectral intervals of 5 to 10 mμ, using a double monochromator. The difficulties attending the use of a sector-disc with photoelectric cells are described in the paper. J. W. T. W.

201. Photoelectric Null-Method for Photometric Measurements. M. Richter. *Zeits. f. techn. Physik,* 13. 10. *pp.* 491–493, 1932.—Describes a circuit for the measurement of transmission factors by the use of two selenium cells. As described in the paper the method is specially adapted for spectrophotometric determinations. It is a balance method which depends on exact similarity of the two cells used, as regards their current/illumination characteristics. The cells employed by the author were those manufactured by the Süddeutsche Apparatefabrik Nürnberg. The spectral sensitivity curve of such cells is given in the paper. J. W. T. W.

202. Device for Augmenting the Precision of Visual Spectrophotometric Measurements. P. Vaillant. *Comptes Rendus,* 195. *pp.* 487–488, *Aug.* 29, 1932.—In the visual spectrophotometry of emission or absorption spectral lines the author finds it advantageous to interpose in the path of both the beams which are being compared a thin plate of glass inclined at 45° to the axis of the observing telescope. This plate superposes on both beams uniformly a reflected beam of a colour and intensity which can be suitably chosen and adjusted. Although there is a loss in the relative importance of the brightness produced by the two beams there is a gain which more than compensates for this loss, in that the sensation of unequal colouring comes into action. Figures are given which show that at the red and blue ends of the spectrum, where the sensitivity, and therefore the accuracy, is lower than in the middle of the visible spectrum ordinarily, the sensitivity is increased from 1 % to 0·5 % at the red end and from 5 % to 2 % at the blue or violet end by superposing the reflected beam. H. L. B.

203. Dichromatic Projection Microphotometer. G. R. Harrison. *Rev. Sci. Instruments,* 3. *pp.* 572–579, *Oct.,* 1932.—A new type of microphotometer is described which combines the advantages of the projection type of Hesthal and Harrison with those of the photoelectric type of Koch. The plate being measured is traversed by a beam of blue light supplied from a small lamp of constant intensity which is used to make the desired density determinations. At the same time it is viewed by means of a beam of orange light from a projection lamp. Thus there is elimination of errors due to light scattered from the optical system. The following are advantages claimed for the instrument: high resolving power, great flexibility and stability of adjustment, high reserve sensitivity, high electrical stability, and ease of handling. It is particularly useful for direct reading work where specific lines are to be selected from a complex spectrum. The instrument is simple and inexpensive. J. J. S.

See also Abstracts 293, 405.

POLARISATION.

204. Photoelectric Method of Measuring the Rotatory Dispersion of Certain Sugars in the Near Ultra-Violet. G. Bruhat and P. Chatelain. *Comptes Rendus,* 195. *pp.* 462–465, *Aug.* 22, 1932.—By means

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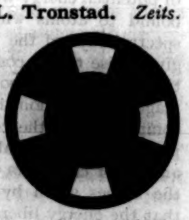
of their photoelectric polarimeter the authors determine the rotatory dispersion of saccharose, glucose and levulose, and show that the accuracy obtainable is such that the error is less than 1 in 200. They also confirm that the formula of Lowry and Richards remains valid beyond the spectral region for which it was originally established. H. L. B.

205. Influence of Molybdates on the Rotatory Power of Xylose. E. Darmois and M. Murgier. *Comptes Rendus*, 195. *pp.* 707–709, *Oct.* 24, 1932.—The rotatory and dispersive powers of mixtures of xylose and molybdates in varying proportions have been determined. The maximum optical activity for the combination is found to be much greater than that for xylose alone. The results are analogous to those found for glucose, but are more marked. W. D. W.

206. Velocity and Mechanism of Racemisation of Rochelle Salt. A. N. and Alexandra J. R. Campbell. *Am. Chem. Soc., J.* 54. *pp.* 3834–3841, *Oct.*, 1932.—Measurements of the velocity of inactivation of Rochelle salt have been made, and an observed drift in the constants is interpreted in the light of a mathematical theory. Experimental evidence for the existence of a complex, based on sign of rotation, OH-ion concentration, and a phase-rule study of the system Rochelle salt–H_2O–NaOH, is adduced. C. B. A.

207. Rotation of Rochelle Salt in Alkaline Media. A. N. and Alexandra J. R. Campbell. *J. Phys. Chem.* 36. *pp.* 2610–2614, *Oct.*, 1932.—The specific rotations found for Rochelle salt in various concentrations of alkali and for different regions of the spectrum show marked variation, which is accounted for on the hypothesis of complex-formation, this being supported by experimental evidence based on reduced OH′-concentration in solutions of NaOH containing Rochelle salt, on greatly reduced conductivity observed when solutions of Rochelle salt and NaOH are mixed, and on the form of the phase rule diagram. T. H. P.

208. Metallography with Polarised Light. L. Tronstad. *Zeits. f. techn. Physik.* 13. 9. *pp.* 408–410, 1932.—Polarised light is useful in metallography as it gives information concerning anisotropy, orientation and state of tension of individual crystals. A difficulty is encountered in rendering the incidence of the polarised light uniform in the polarisation microscope. This difficulty is met by the author by the use of a special "epiphragm" consisting of four portions of sectors, spaced as shown in the diagram. This epiphragm allows not only the plane of incidence, but also the azimuth of the polarised light to be altered. E. E. F. d'A.



209. Rotatory Dispersion and Circular Dichroism of Camphor-β-Sulphonic Acid in the Region of Absorption. T. M. Lowry and Helen S. French. *Chem. Soc., J. pp.* 2654–2658, *Oct.*, 1932.—Aqueous solutions of camphor-β-sulphonic acid show a maximum absorption $\epsilon = 35$ at 2840 Å., and a maximum circular dichroism (measured by the use of a Fresnel rhomb made of fused silica) $\epsilon_r \sim \epsilon_l = 1 \cdot 535$ at 2900 Å. The rotatory dispersion shows a positive maximum $[\alpha] = 2000°$ at 3090 Å., a reversal of sign at 2950 Å., and a negative maximum $[\alpha] = -2450°$ at 2690 Å. These results are similar to those obtained for camphor, and again show that the ketonic band is composite in character. [See also Abstract 2373 (1932).] C. B. A.

RADIATION, EMISSION.

210. Cosmic Radiation at High Altitude. A. Piccard and M. Cosyns. *Comptes Rendus,* 195. *pp.* 604–606, *Oct.* 10, 1932.—Observations relative to cosmic rays were made in a balloon ascent of 18th August, 1932. The radiation was measured by means of two ionisation chambers; one of the type used by Kolhörster containing air at normal pressure, the other containing CO_2 at 10 atmospheres. A curve is given showing the relation of the ionisation to the subjacent mass of the atmosphere. The values given by the Kolhörster chamber are indicated directly in pairs of ions formed per c.c. per sec. Between 150 and 160 mm. external pressure the points are on the exponential curve $I = 775e^{-0 \cdot 0855p}$ (p being expressed in cm. Hg) with the exception of the point at 340 mm. Hg which is distinctly higher. Outside these limits the points deviate from the exponential, the deviation near the earth being due to radioactivity from it and to emanation from the lower atmosphere. At high altitudes the points are below the exponential, the values being represented, saving experimental errors, by the empirical formula $I = 775e^{-0 \cdot 0855p} - 1810e^{-0 \cdot 395p}$. These results are in good accordance with those of Kolhörster and of Regener, but in contradiction with those of Millikan. A screen of lead 4 to 5 cm. thick gave a diminution of between 20 and 35 %. Two Geiger tubes turnable in all directions gave in the horizontal and vertical positions the same number of discharges per min. within about 1 %. The interpretation of all these facts as a whole is not easy. The usual hypotheses do not suffice. J. J. S.

211. Cosmic Radiation. E. Sevin. *Comptes Rendus,* 195. *pp.* 698–701, *Oct.* 24, 1932.—In a previous paper the author has argued that the evolution of the universe has been characterised by a progressive diminution of potential energy which results in two effects, one concerning the particles bound to atoms which promotes displacement towards the red of the spectral rays of the nebulæ, the other concerning the free particles and giving rise to the cosmic radiation. It is for the protons that this radiation has great importance. The undulatory conception of the electromagnetic radiations leads to an explanation of both the hard and the soft components of the cosmic radiation by a single process. In the present paper is given a calculation of the potential energy expressed in volts and other constants of the cosmic radiation and these are compared with the values given by Jeans and Millikan. It is on account of the spin that the energy liberated is able to pass to the ether. J. J. S.

212. Variation of Cosmic Radiation. W. Messerschmidt. *Zeits. f. Physik,* 78. 9–10. *pp.* 668–689, *Oct.* 18, 1932.—Variations of cosmic radiation due to meteorological influences are discussed. For various degrees of absorption by lead the air pressure coefficients are given (6926 registered hours). The intensities of the weak scattered radiation of the atmosphere observed with partially opened lead screen, follow the temperature of the outer air and therefore show a solar time period which also persists with radiation entering obliquely and horizontally (11,321 registered hours). A sidereal time period could not be found. A direct thermal influence on the ionisation exists. By it, however, the investigations of the variation with regard to the sheltered arrangement of the

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apparatus are not interfered with (1400 registered hours). Since the total variations of the cosmic radiation at sea-level can be explained by meteorological influences the intensity of the primary cosmic radiation may be regarded as constant. Variations due to the process of ionisation of the cosmic radiation are then described. After reduction of the measured values by the correction factors obtained there persists a statistical variation which is caused by the ionisation process itself. In this connection the questions of the specific ionisation of the cosmic radiation are referred to. At intervals of several hours effects appear with extremely large quantities of ions—so-called collisions. J. J. S.

213. Electron Orbit in the Magnetic Equatorial Plane of the Earth. W. F. G. Swann. *Frank. Inst., J.* 214. *pp.* 465–471, *Oct.*, 1932. —In view of the recent recognition of the possibilities of electron energies much higher than would have seemed reasonable previously and particularly of Compton's recent experiments on the variation of cosmic ray intensity with latitude, the problem of electronic motion in the magnetic equatorial plane at zero latitude has become of importance. The formula for this case can be deduced from particularly elementary considerations for motion in the magnetic equatorial plane, and such a derivation is given in the present paper. J. J. S.

214. Self-Recording Cosmic-Ray Electrometer and Depth-Ionisation Curve. J. M. Benade. *Phys. Rev.* 42. *pp.* 290–297, *Oct.* 15, 1932.—A self-contained automatic recording electrometer connected to a collecting rod in a thin steel-walled ionisation chamber was used to measure intensity of cosmic rays at various depths in Konsar Nag, Kashmir. The lake is about 280 ft. deep. Its surface is about 11,600 ft. above sea-level and its water is practically free from radioactive matter. The electrometer consists of two short parallel phosphor-bronze ribbons attached at one end only. Their divergence is recorded photographically at eight minute intervals, and at the end of each hour the fibres are automatically recharged. The temperature, depth and position of the instrument with respect to the vertical, are also recorded along with electrometer deflections. The curve obtained corresponds to those of Millikan and Cameron to a depth of 50 m. but at greater depths it more closely parallels that of Regener. The slopes of these curves at any particular depth seem to depend upon the type of the ionisation chamber as well as upon the intensity of the cosmic radiation at that depth. AUTHOR.

215. Electrodeless Discharge and Sources of Monochromatic Radiation. F. Esclangon. *Rev. d'Optique,* 11. *pp.* 399–404, *Oct.*, 1932. —A method of producing monochromatic radiation by employing the continuous waves of an electrodeless discharge is described. The electrodeless tubes containing the gas or metallic vapour are placed inside the spiral of a self-induction coil. Rare gases are mixed with the vapour in the tube; such tubes shine brightly when placed inside the spiral. It has been possible in this way to obtain the emission spectra of the hydrogen arc, of helium and of several metals as spectra consisting of intense rays easily separable from each other. Different spectra can be obtained merely by altering the tube in the spiral without disconnecting or modifying the optical adjustments. The emitted rays are fine and are not displaced with regard to the rays usually obtained. W. R. A.

See also Abstract 179.

RADIATION, GENERAL THEORY.

216. Atoms of Action, Electricity and Light. A. Fleming. *Phil. Mag.* 14. *pp.* 591–599, *Oct.*, 1932.—One of the arguments frequently adduced in favour of the quantum nature of light, is that under exceedingly feeble illumination the photoelectric effect shows no measurable time-lag. The author points out that this would involve no difficulty on the classical theory if an atom could absorb all the energy incident on an area some hundreds or thousands of times its own cross-section. He cites experiments which show that a wireless aerial does so, and offers a qualitative explanation of the fact. The proposal is made to call the unit of action (usually denoted by h) a " Planck." A suggestion that neither time nor space may be indefinitely divisible is put forward. J. H. A.

REFLECTION. REFRACTION AND DISPERSION.

217. Total Reflection at a Semi-Silvered Glass Surface. A. de Gramont. *Rev. d'Optique,* 11. *pp.* 405–410, *Oct.*, 1932.—The variation of reflection factor with the thickness of the silvering is studied for internal incidence at the hypotenuse face of a totally-reflecting prism. At an angle of incidence of 43° the curve of reflection against transmission falls rapidly as the film thickness increases, reaching a minimum at transmission factor $= 0\cdot6$, the reflection then being diminished by about one-half. The reflection increases again more slowly until total reflection is reached. An opaque film thus diminishes the intensity of reflection. No similar minimum was observed with external incidence on the silvering. Investigation of the variation of reflection with angle of incidence showed that the limiting angle is unaffected but that the intensity at it is greatly diminished by the silvering. At greater angles of incidence the reflected intensity falls after 43° and passes through a minimum at about 51°, then rising again until at 75° it is slightly greater than at the limiting angle. It is suggested that total reflection is replaced by metallic reflection and this is demonstrated by measurements in which mercury, of known reflecting power, is placed in contact with the glass. C. B. A.

218. Mach Effect and Law. B. Demetrovic. *Comptes Rendus,* 195. *pp.* 269–271, *July* 18, 1932.—Wherever the Mach effect occurs the ordinary laws of geometrical optics imply the existence of such effect, though of an intensity less than would be inferred from what is seen by the eye. The effect would seem to be partly physiological and partly physical (diffraction) [see Abstract 991 (1926) and following Abstract]. C. A. S.

219. Mach Effect. F. Wolfers. *Comptes Rendus,* 195. *pp.* 653–655, *Oct.* 17, 1932.—There must be a definite physical cause of the effect [see preceding Abstract], though the physiological effect may facilitate observation. An analogous effect with X-rays is at least partially explicable by pseudo-reflection [see Abstract 2458 (1932)]. To determine whether this is a complete explanation of the Mach effect accurate photographic determinations of intensity are required. C. A. S.

220. Diagrams of a Surface Element in Rotating Systems. H. Boegehold and M. Herzberger. *Zeits. f. Physik,* 78. 7–8. *pp.* 445–451, *Oct.* 12, 1932.—The author first reviews the relations obtained for a rotating system by the Abbe sine relation and the Lihotzky–Staeble isoplanatic relation. The latter deals only with terms of the first order for the surface elements. The author states rules by which, from calculation from the rays proceeding from a point on the axis, information can be obtained relating to the caustic for an adjoining point, when no assumptions are made regarding errors of axial aberration for points on the axis, and second order terms are considered. These relations are applied in particular to the special cases of diagrams of nearly symmetrical and regular fields. R. S. R.

221. Isoplanatic Diagrams by Means of Optically-Centred Systems. E. Lihotzky. *Zeits. f. Physik*, 78. 7–8. *pp.* 452–453, *Oct.* 12, 1932.—The author states that the results obtained by Boegehold and Herzberger [see preceding Abstract] have been obtained by him in a somewhat different way, but leading to essentially the same results. Corresponding formulæ are given in the form of circular functions for another case not treated by Boegehold and Herzberger, but which is to be explained in detail in another paper. R. S. R.

222. Refractivities of Binary Mixtures of Benzene. A. R. Martens and B. Collie. *Chem. Soc., J. pp.* 2658–2665, *Oct.*, 1932.—The partial vapour pressures at 70° C. of the compounds chlorobenzene, bromobenzene, di-methylaniline, aniline, anisole and benzonitrile in solutions of benzene have been measured. In each case the whole range of concentrations from pure benzene to the pure polar compound was covered. The refractive index at 25° C. for the line 6563 Å. is also given for solutions of each of the above compounds in benzene, as also for a solution of phenol in benzene. For each pair, except possibly benzonitrile in benzene, the molar refractivity (using the *average* molecular weight of the solution) can be calculated additively from the refractivities and proportions of the constituents. An interpretation of the results is attempted in terms of the dipole moment and molecular radius of the solvent molecule, together with the dielectric constant of the medium, benzene. J. H. A.

223. Telescopes with Micrometer Cross-Wires. W. Uhink. *Zeits. f. Instrumentenk.* 52. *pp.* 435–442, *Oct.*, 1932.—In measurements of separation with simple telescopes fitted with micrometer cross-wires, errors of ±0·03 % can be introduced by inexact focussing. In a telescope with a fixed or movable intermediate lens, these errors disappear when the anallactic point is brought into the objective. When the anallactic point lies elsewhere in the telescope the errors are still less than in the simple instrument. C. B. A.

224. Universal Vertical Illuminator for Microscopes. J. Flügge. *Zeits. f. Instrumentenk.* 52. *pp.* 446–452, *Oct.*, 1932.—Constructional details are given for a new illuminating system for microscopes which allows of a simple transition from bright to dark field illumination in reflected light. Bright field is obtained in the usual way. For dark field, the incident light is reflected down from a ring-mirror into an aspherical concave mirror which concentrates it at almost grazing incidence on the object under examination. The system can also be used for illumination in transmitted light, and it can be adapted for photographic observation. Examples of the latter are given. C. B. A.

225. Simplified Registering Infra-Red Spectrometer. C. Leiss. *Zeits. f. Physik*, 78. 9–10. *pp.* 704–706, *Oct.* 18, 1932.—A description of a new registration arrangement which has been made for use with a spectrometer of which an account has previously been given [see Abstract 1194 (1932)]. J. J. S.

226. New Wide Angle Objective. H. Schulz. *Zeits. f. techn. Physik*, 13. 10. *pp.* 487–491, 1932.—Starting with the Hill form of wide angle objective which has a concave lens at the front, the general rules are set out and formulæ are obtained for a wide angle objective with mean ratio for the aperture and flat field of view. In comparison with the Hill objective important improvements are obtained with regard to the intensity of the transmitted light and the angle of the opening, while the decrease of brightness at the edges can be avoided. An objective constructed on these lines, when tested, confirmed the theoretical conclusions. Pictures are reproduced to illustrate the improved results. On these lines it is hoped to increase the angle to 210° and so obtain kinematographic changes of the sky and clouds. R. S. R.

227. Correcting Lenses for Refractors. F. E. Ross. *Astrophys. J.* 76. *pp.* 184–201, *Oct.*, 1932.—A short history is given of the use of zero-power correcting lenses with visually corrected refracting telescopes. The object of the corrector is to change the refractor over into a photographically corrected telescope, in order that it may be better adapted for spectrum photography. An analysis and reconstruction of the optical design of the 40-inch lens of the Yerkes Observatory is presented, furnishing data useful for the proper design of the corrector lens. The design and data on the corrector lens are given, and a comparison of its performance with that of the older corrector lens, showing gain in speed. The general theory of corrector lenses of this type is presented in some detail; in particular, it is shown that there is a large outstanding optical aberration, chromatic magnification, which cannot be eliminated, but is capable of material reduction by proper design. The effect of flexure of the telescope tube is considered, and found to be negligible. It is pointed out that the most serious outstanding defect of the corrector lens is secondary axial-colour aberration. The question of reducing this by suitable choice of glass is discussed, and it is shown that little can be expected in this direction. AUTHOR.

See also Abstracts **19, 79, 260, 275, 293.**

SPECTROSCOPY.

228. Interferometric Measurements in the Spectrum of Krypton. C. V. Jackson. *Roy. Soc., Proc.* 138. *pp.* 147–153, *Oct.* 1, 1932.—The wave-lengths of the ten bright violet lines of the first spectrum of Kr have been measured, with an accuracy of about ± 0·0001 Å., by interferometric comparison with the primary standard. This group of lines appears to be very suitable as a standard of length for spectroscopic purposes, since it is situated in a very convenient part of the spectrum and the lines have a very high degree of homogeneity, about twice that of the Ne lines; with a suitable tube, the lines can be photographed with a short exposure, and are suitably spaced for the evaluation of the thickness of an étalon even when its approximate value is in error by several hundred wave-lengths. The lines λλ5870, 5570 and 5562 are not considered suitable for standards. H. H. Ho.

229. First Spark Spectrum of Antimony. R. J. Lang and E. H. Vestine. *Phys. Rev.* 42. *pp.* 233–241, *Oct.* 15, 1932.—The first spark

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spectrum of antimony has been analysed by using the radiation from three sources, the hollow kathode in He and in Ne, and the vacuum spark. The spectrum extends from the infra-red to the extreme ultra-violet with strong lines scattered throughout most of the entire range. Many important lines lie in the visible and near ultra-violet and the spectrum is weakest in the 2000 Å. region where the strong lines of the arc spectrum fall. The multiplets arising from the combination of the deepest terms (s^2p^2) ^{3}P′D′S with the next most important configuration (s^2ps)^{3}P′P occur between λ1300 and λ2000. Two members of the singlet series ′P — ′D and two members of the singlet series ′P — ′S of the above configurations give an approximate value for the deepest term of 150,000 cm.$^{-1}$ and an ionisation potential of about 18 volts. Some 50 energy levels are located based upon the classification of nearly 200 lines. Tables of term values and wave-lengths are given. AUTHORS.

230. Recombination Spectrum of the Positive Column in Metal Vapours with Doublet Series. H. Krefft. *Zeits. f. Physik*, 77. 11–12. *pp*. 752–773, *Sept*. 3, 1932.—The observations were made with discharge tubes containing neon (5 to 20 mm. pressure) as base gas, and for the less volatile metals the tube was heated in an oven. For metals of the first and third groups giving doublet series, the light emission of the positive column is characterised by the appearance of the recombination spectrum. The recombination spectrum, identified by the continuous spectrum associated with the series limits and other features, was obtained for the metals sodium, potassium, rubidium, caesium, indium and thallium. At normal current densities a pressure of metallic vapour of 0·01 mm. or more sufficed to produce the spectrum. In addition to the descriptions and photographs of the spectra, intensity measurements, by a photoelectric method, of the series lines for the alkali metals are reported. The bearing of the work on the theory of the mechanism of the positive column is discussed. W. S. S.

231. Radiation from a Beam of Electrons in Mercury Vapour. L. R. Maxwell. *Frank. Inst., J*. 214. *pp*. 599–603, *Nov*., 1932. *Phys. Rev*. 42. *pp*. 148–150, *Oct*. 1, 1932.—A description is given of the Hg spectrum produced by a beam of electrons in mercury vapour. Some of the lines extend beyond the image of the electron beam, particularly the resonance line 2537 Å. A table is given of the most prominent lines in two groups, extended lines and normal lines, and a picture of a spectrogram obtained. Outside of the electron beam there are atoms in the 2^3S_1 state which will give rise to transitions to the 2^3P_0 and 2^3P_1 levels, but with practically the exclusion of transitions to the 2^3P_2 state. Thus the fine structure of the 2^3S_1 level plays an important part in the radiation phenomena, supporting the conclusion of Randall and Webb to account for the discrepancies found for the mean life of this state. J. J. S.

232. Series in the Complex Spectrum of Singly Ionised HgII. T. S. Subbaraya. *Zeits. f. Physik*, 78. 7–8. *pp*. 541–554, *Oct*. 12, 1932. —The first spark spectrum of mercury was further investigated [see Abstract 1968 (1932)] and a number of new terms were found, which makes complete the group to be expected for the configuration $5d^96s6p$. Some terms related to other configurations were also found. A number of series of the modified Ritz type, such as Paschen first discovered in neon, were identified, which give an indication of the position of the $^1S_0$ terms of

HgIII. From these series relations it appears to follow that a series of terms which McLennan, McLay and Crawford, in the search for a new arrangement of the HgII spectrum, explain on the basis of a strict *j—j* coupling, actually are higher members of such a series. J. J. S.

233. Absorption Spectra of the Samarium Ion in Solids. Part I. F. H. Spedding and R. S. Bear. *Phys. Rev.* 42. *pp.* 58–75, *Oct.* 1, 1932.—The visible and ultra-violet absorption of large single monoclinic crystals of $SmCl_3 . 6H_2O$ has been studied at seven temperatures between 15° and 298° K. Measurements of the absorption lines and bands are given as they appear at four of these temperatures. The influence of temperature on the positions of lines and multiplets and on the width and intensity of lines is discussed. All phenomena are explained on the basis of three direct effects of temperature change on the crystal: Lattice contraction and expansion, temperature vibration of the lattice with consequent fluctuations in crystal fields, and Boltzmann distribution of the ions between excited lower levels about 160, 210 and 300 $cm.^{-1}$ above the basic level. [See following Abstract.] AUTHORS.

234. Absorption Spectra of the Samarium Ion in Solids. Part II. F. H. Spedding and R. S. Bear. *Phys. Rev.* 42. *pp.* 76–85, *Oct.* 1, 1932.—Additional lines of the $SmCl_3 . 6H_2O$ absorption spectrum obtained from conglomerates of crystal fragments are reported for four temperatures between 20° and 300° K. These new lines, along with ones previously reported [see preceding Abstract] for single-crystal absorption, are used to establish the existence of excited lower levels situated at 145, 160, 204, 217 and roughly 300 $cm.^{-1}$ above the basic level. It is probable that there are other levels more than 400 $cm.^{-1}$ above the basic one. Two components of the 300 level, at 295 and 315 $cm.^{-1}$, are thought to be present, and there are indications that the other levels, particularly the basic one, may be complex. AUTHORS.

235. Intensities of Spectral Lines of He, Hg and N_2 Excited by Electron Bombardment. O. Thieme. *Zeits. f. Physik,* 78. 5–6. *pp.* 412–422, *Oct.* 4, 1932.—The relative intensities of 16He and 13Hg lines excited by electron bombardment at extremely low pressures are determined photographically for excitation energies ranging from 9–400 volts. From the known intensity ratios of He to Hg at 60 volts excitation energy, as determined by Hanle and by Schaffernicht [see Abstracts 1972 and 3429 (1930)], the absolute intensities of the above lines are obtained. Excitation functions for molecular spectra and especially for N_2 are determined; it is found that they are similar to those for atomic spectra. F. C. C.

236. Nuclear Spin and Magnetic Moment of Li^7. L. P. Granath. *Phys. Rev.* 42. *pp.* 44–51, *Oct.* 1, 1932.—Measurements have been made on the hyperfine structure of the $^3P_0$—$^3S_1$ group of the λ5485 line of $(Li^7)^+$ with a Fabry-Perot étalon crossed with a 21 ft. Paschen-mount concave grating. The method of using the étalon with an astigmatic grating is discussed. The results of the measurements on the Fabry-Perot patterns of the $^3P_0$—$^3S_1$ group indicates a nuclear spin of 3/2 for Li^7 and a nuclear magnetic moment of 3·29 times the theoretical magnetic moment of the proton. AUTHOR.

237. Intensities of the Hyperfine Structure Components of the Most Intense Lines of the Visible Spectrum of HgI. Hyperfine Structure of the Term $(Hg^{199})7^3D_2$. J. Gilles. *Comptes Rendus,* 195. *pp.* 579–580, *Oct.* 3, 1932.—The intensities of the hyperfine structures of the most intense visible HgI lines emitted by an oscillatory discharge and a low-pressure cooled arc are observed. In general the observations agree with those of Schüler and Murakawa; only a few faint components of the isotope Hg^{199} are in disagreement with the theoretically predicted intensities. This is probably due to the fact that the coupling is not exactly of Russell–Saunders type. It is shown that the separation of the 7^3D_2 term of $Hg^{199}I$ is about 200×10^{-3} cm^{-1}. J. E. K.

238. Collision Phenomena in the Optical Excitation of the Various Mercury Isotopes. S. Mrozowski. *Zeits. f. Physik,* 78. 11–12. *pp.* 826–843, *Oct.* 28, 1932.—The hyperfine structure of the resonance radiation of Hg vapour, excited by filtered-radiation under various conditions, is further investigated with a new experimental arrangement giving increased light power, and the previously discovered displacement effect of one of the components is established with a considerably increased degree of exactitude. The addition of small quantities of He or N_2 causes selective collision transitions between the various hyperfine structure components; on the other hand, an increase in the vapour density of the mercury gives equal transition probabilities for all components. Under the same conditions a Füchtbauer effect is observed which permits a study of the hyperfine structure of the visible triplets by addition of N_2. It is found that the hyperfine structure is independent of the composition of the exciting resonance line; this is explained as a consequence of the collisions of metastable atoms with the Hg atoms of the various isotopes. **Erratum,** ibid. 79, 7–8, p. 562, Dec. 3, 1932. J. E. K.

239. Illumination Period of Mercury Resonance Line 2537 Å. S. Mrozowski. *Zeits. f. Physik,* 78. 11–12. *pp.* 844–846, *Oct.* 28, 1932.—On the basis of the accepted interpretation of the hyperfine structure of the mercury resonance line 2537 Å. it is shown that discrepancies exist between the results of absorption and illumination-period measurements (rotation of the plane of polarisation of resonance radiation in weak magnetic fields) which are bigger than the limits of error of the corresponding methods of measurement. J. E. K.

240. Near Ultra-Violet Bands of Silicon Tetrachloride. A. C. Datta. *Zeits. f. Physik,* 78. 7–8. *pp.* 486–491, *Oct.* 12, 1932.—The bands between 2770 and 3100 Å., produced by passing an uncondensed discharge (12,000 volts) through $SiCl_4$ vapour at 2 mm. pressure, have been studied with a high dispersion spectrograph. The observed displacements of the bands due to $Si^{28}Cl^{37}$ and $Si^{29}Cl^{35}$ agree closely with the calculated values. The heat of dissociation corresponding with the lowest state is about 4·9 volts. H. F. G.

241. Spectrum of Potassium Hydride. G. M. Almy and C. D. Hause. *Phys. Rev.* 42. *pp.* 242–266, *Oct.* 15, 1932.—The $^1\Sigma \rightarrow {}^1\Sigma$ molecular spectrum extending from 4100 Å. to 6600 Å. has been photographed with prism spectrographs with a d.c. potassium arc in hydrogen as source. In absorption spectrographs, also attempted, the bands were masked by alkali bands except in a short region, 4600 Å. to 4800 Å. The spectrum is of the many-lined type. Analysis disclosed 29 bands falling into five v' progressions. Each band consists of P and R branches only. The rotational and vibrational constants, which fall into line with the corresponding values for LiH and NaH, are surprisingly different in the two states. B_v' and ω_v' show an anomaly, rising with increasing v' for low values of v', then decreasing. Extrapolation of the vibrational levels indicates that the products of dissociation in the two states differ by the energy of the resonance lines of K (1·60 volts). Heats of dissociation of 1·25 and 2·06 volts are obtained for the excited and ground states, respectively. From potential energy curves a Franck-Condon diagram of intensity is drawn and is in good agreement with observed intensities.

AUTHORS.

242. Far Infra-Red Spectra of Gases. J. Strong and S. C. Woo. *Phys. Rev.* 42. *pp.* 267–278, *Oct.* 15, 1932.—The envelope of absorption in the far infra-red is determined for 14 gases by the residual-ray technique. The pure rotation envelopes of HCl and NH_3 are compared with the envelopes of the R-branch of their oscillation-rotation bands. The formula $I_j(\text{vib.} - \text{rot.})/I_j(\text{rot.}) = \text{const.}/\nu_r(1 - e^{-h\nu_r/kT})$ is used to modify the shape of the R-branch for comparison with the pure rotation envelopes. A thermopile is described for use when the receiver area is square. The novel feature of this thermopile lies in the use of only one receiver for four junctions. Also the cold junctions stay at the temperature of the receiver for all temperature fluctuations which require a time greater than one minute. Drifting is consequently greatly reduced. Absorption cells are described which are useful for wave-lengths greater than 20μ. The windows for these cells are made from 1μ lacquer films covered with a 50μ layer of Kahlbaum paraffin. Interference effects are reduced to a minimum by the use of copper ribs across the windows, a device to prevent pressure changes in the cell so the windows will not bulge and mechanically accurate mounting of the cells. Interference effects are also reduced because the beam passing through the cells has a large angular divergence. AUTHORS.

243. Infra-Red Spectrum of H^2Cl. J. D. Hardy, E. F. Barker and D. M. Dennison. *Phys. Rev.* 42. *pp.* 279–289, *Oct.* 15, 1932.—The fundamental absorption band due to HCl molecules involving the heavier isotope of hydrogen has been observed, using a cell 700 cm. long with gas at atmospheric pressure. It lies in the region of 4·8 μ. Both ordinary HCl and samples enriched in H^2 were examined. Nineteen lines have been measured in the band of H^2Cl^{35}, and seventeen in the band of H^2Cl^{37}. The estimated abundance of H^2 relative to H^1 is 1 to 35,000. A satisfactory equation has been developed for the positions of these lines on the basis of measurements by Meyer and Levin upon the bands of H^1Cl, assuming identical dimensions and force fields for both molecules. The parameter ρ of this equation, representing the ratio of the reduced masses for H^2Cl and H^1Cl, has been adjusted to give the best agreement with the observed frequencies, and is found to be $\rho = 0{\cdot}514430 \pm 0{\cdot}000004$. Sources of error other than those involved in the observations are discussed, and an attempt is made to evaluate them. When these are taken into account, the values indicated for the mass of H^2 (on the scale $H^1 = 1{\cdot}00778$) and for the mass defect are: mass $H^2 = 2{\cdot}01367 \pm 0{\cdot}00010$, mass defect $= 0{\cdot}00189 \pm 0{\cdot}00010$. These values are compared with the results obtained by Bainbridge with the mass spectrograph. AUTHORS.

244. Absorption Spectrum of Nitric Oxide. A. Herrmann. *Ann. d. Physik.* 15. 1. *pp.* 89–108, *Oct.*, 1932.—The bands between 2491 and 2459 Å. have been photographed and measured again. No magnetic rotation has been observed and electric fields up to 36,000 volts/cm. have no effect. Bands in the neighbourhood of the second predissociation limit at 2459 Å. have been photographed for temperatures from −15° to 500° C. Sharpness of the lines is not affected by temperature. F. S.

245. Spectrum of Adsorbed Iodine. D. Chilton and E. Rabinowitsch. *Zeits. f. phys. Chem.* 19. *Abt.B.* 2–3. *pp.* 107–112, *Oct.*, 1932.—The absorption spectrum of iodine adsorbed on chabasite exhibits a pronounced maximum at 4950–5000 Å., and a smaller maximum at 4350–4400 Å.; there is also possibly a band at about 4000 Å. The extension of the absorption towards the ultra-violet region is attributable to the operation of adsorption forces, whilst the appearance of 2 or possibly more maxima suggests that several distinct adsorbed layers exist. H. F. G.

246. Rotational Analysis of the First Negative Bands of the CO^+ Molecule. R. F. Schmid. *Phys. Rev.* 42. *pp.* 182–188, *Oct.* 15, 1932.—By using the light of a graphite hollow kathode in a CO_2 atmosphere, the $^2\Sigma \rightarrow {}^2\Sigma$ (first negative) CO^+ bands at 2299·7, 2325·2, 2419·4, 2445·8, 2474·2, 2504·5, 2577·7, 2607·2, 2638·7 and 2672·3 Å. have been photographed in the second and third orders of a 21-ft. Rowland grating. The analysis gives the rotational constants: $B'_e = 1{\cdot}778$ cm.$^{-1}$, $a' = 0{\cdot}032$ cm.$^{-1}$ and $B''_e = 1{\cdot}954$ cm.$^{-1}$, $a'' = 0{\cdot}019$ cm.$^{-1}$. The ρ-type doubling of both of the upper and lower $^2\Sigma$ states seems to be very small. Only lines with high rotational quantum numbers show broadenings and sometimes measurable doublings. Definite perturbations could not be observed. AUTHOR.

247. Products of Dissociation in Nitrogen. J. Kaplan. *Phys. Rev.* 42. *pp.* 97–100, *Oct.* 1, 1932.—Use is made of four regions of predissociation in the triplet band systems of nitrogen in order to determine the products of dissociation from the known triplet states. Mulliken's proposal that the products of dissociation in the $^3\Sigma\mu^+$ level are two ^4S atoms does not agree with the evidence which is presented here. This evidence proves that the products are a ^4S and a ^2D atom. The bearing of these results on the heat of dissociation of nitrogen is briefly discussed. AUTHOR.

248. Calculation of the Quantum Defect for Highly Excited S States of Para- and Ortho-Helium. L. P. Smith. *Phys. Rev.* 42. *pp.* 176–181, *Oct.* 15, 1932.—Experimental term values for the S states of para- and ortho-helium for the case when one electron is in the ground state and the other is in a highly excited S state can be represented by the formula $E = -Rh/(n - \Delta_{1,2})^2$; Δ_1 and Δ_2 being the quantum defects for the ortho and para systems, which have the respective numerical values 0·298 and 0·140. The object of the present paper is to calculate the values of Δ_1 and Δ_2 by a convenient method quite different from that used by Hylleraas [see Abstract 1267 (1931)]. Neglecting the polarisation of the atom core, the results obtained for Δ_1 and Δ_2 are 0·289 and 0·160, respectively, in contrast to the corresponding values 0·230 and 0·122 obtained by Hylleraas before correcting for polarisation. This difference is due to the more accurate wave functions obtained here and indicates that the effect of polarisation is not as great as it would appear from the calculations of Hylleraas. AUTHOR.

249. Vibrations of Polyatomic Molecules. N. Rosen and P. M. Morse. *Phys. Rev.* 42. *pp.* 210–217, *Oct.* 15, 1932.—An exact solution of the wave-equation is found for a form of one-dimensional potential energy which may be of use in discussing polyatomic molecular vibrational energies. An example of its use is given in an analysis of the vibration of the nitrogen in the ammonia molecule. The potential energy for this atom has two minima a distance $2x_m$ apart, separated by a "hill" of height H. The values of x_m and H are not known directly from band spectral data, and are needed for a full analysis of the spectrum. By joining two potential curves of the sort dealt with in the first part of this paper in a symmetric manner, a curve simulating that for the nitrogen atom in ammonia was formed. It was found that for certain values of the constants fixing this curve, the allowed vibrational energies were the same as the experimentally determined values for ammonia. The corresponding value of x_m was 0·38 Å., and that of H was ¼ electron-volt. These values are probably near the correct values of x_m and H for ammonia. AUTHORS.

250. Spectroscopic Determination of Electron Affinities. H. Kuhn. *Zeits. f. phys. Chem.* 19. *Abt.B.* 2–3. *pp.* 217–218, *Oct.*, 1932.—It is pointed out that the first method used by Lederle [see Abstract 4293 (1932)] for the calculation of electron affinities is based upon an incorrect assumption, and that the second method, which involves an empirical extrapolation, only gives an accuracy within 1 to 2 k.cal. H. H. Ho.

251. Luminescence of Solid Nitrogen. J. Kaplan. *Phys. Rev.* 42. *pp.* 86–96, *Oct.* 1, 1932.—An explanation is proposed for nearly all of the radiations that have been observed by McLennan and his collaborators in the luminescence of solid nitrogen. The bands are associated with known bands of the second-, fourth- and first-positive groups of nitrogen; with hitherto unobserved second-positive bands; with a possible new system and with new modifications of the first-positive bands. These new modifications of the first-positive bands are related to the spectra of the aurora, night-sky and planetary absorption spectra. As a result of this correlation, it is now possible to see why Vegard identified the aurora spectrum as the spectrum of solid nitrogen and then proposed his theory of the upper atmosphere. AUTHOR.

252. Singlet Principal System of Mercury. Y. Ishida and S. Hiyama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 383. *pp.* 79–82, *Sept.*, 1932. *In English.*—To test the scheme proposed by Paschen the Stark effects have been investigated. F. S.

253. Theory of Uncoupling and Formulæ for the Stark Effect in H_2. J. K. L. MacDonald. *Roy. Soc., Proc.* 138. *pp.* 183–204, *Oct.* 1, 1932.—The uncoupling of the electronic angular momentum from the nuclear axis due to rotation of the molecule is examined for light molecules by means of wave mechanics. Certain H_2 states are considered in detail and the correlation of experimental and theoretical results has been commenced. The theory developed is applied to the Stark effect and general formulæ are obtained, but lack of experimental data checks further progress. A. H.

254. Stark Effect with Sudden Changes of Field. H. R. v. Traubenberg, R. Gebauer and E. Schrödinger. *Zeits. f. Physik.* 78. 5–6. *pp.* 309–317, *Oct.* 4, 1932.—The Stark effect with sudden changes of field was investigated for the non-adiabatic case and it was found that the splitting then also answers to the value of the field for the time being if the condition for adiabatic behaviour is not fulfilled. J. J. S.

255. Raman Spectrum of Germanium Tetrachloride. R. R. Haun and W. D. Harkins. *Am. Chem. Soc., J.* 54. *pp.* 3917–3919, *Oct.*, 1932.—Data are tabulated for 11 Raman lines, exciting lines and displacements of $GeCl_4$, and are compared with displacements for the tetrachlorides of C, Si, Ti and Sn. The wave numbers fall under four types of frequencies, each of which is a nearly linear function of the atomic number. The Raman spectrum of $GeCl_4$ corresponds to four displacements of wave number with values: $\omega_2 = 132$, $\omega_4 = 171$, $\omega_1 = 397$, $\omega_3 = 451$. N. M. B.

256. Vibration of Atoms at the End of Organic Molecules: Raman Effect and the Carbon-Chlorine Bond. W. D. Harkins and R. R. Haun. *Am. Chem. Soc., J.* 54. *pp.* 3920–3931, *Oct.*, 1932.—A continuation of the study of the effect of length of an organic molecule and splitting of the hydrocarbon chain upon the vibration of an atom at the end of the molecule [see Abstract 1639 (1932)]. Raman data are recorded for 11 paraffin chlorides. It is concluded that the vibration at the C-Cl bond is mainly between the Cl atom and the adjacent C atom; the fundamental C-Cl frequency is lowered considerably by a branching of the paraffin chain; the strength of the C-halogen bond is nearly constant with increase from 2 to 5 in the number of C atoms in the molecule, but is progressively weaker in the halides of the secondary and tertiary derivatives; a branching of the hydrocarbon chain weakens the C-halogen bond, but tends to have no effect if it occurs sufficiently far from the halogen atom; a marked peculiarity is shown by a frequency about 80 $cm.^{-1}$ higher than that characteristic of the halides; a frequency about half that of the fundamental is associated with the C-halogen bond. N. M. B.

257. Raman Effect in Solutions of Cupric Salts. A. da Silveira. *Comptes Rendus,* 195. *pp.* 652–653, *Oct.* 17, 1932.—When solutions of cupric sulphate and nitrate are examined as previously described [see Abstract 3284 (1932)] the sulphate shows a new line at 450 $cm.^{-1}$, with a triplet at 1058, 1110 and 1143, attributed to SO_4'', and exhibiting a new instance of suppression of degeneration [see Abstract 5028 (1932)]; the nitrate shows lines closely resembling those of calcium nitrate. C. A. S.

258. Raman Effect in Molecules and Crystals. E. Fermi. *Accad. d'Italia, Mem.* 3. 3. (*Fisica*) [22 *pp.*], 1932.—In the Raman spectrum of a molecule, gaseous or liquid, lines are commonly observed which correspond to some or all of the frequencies of oscillation of the molecule in its fundamental electronic state. More rarely, lines are observed corresponding to a variation in the state of rotation. A single case is known of a Raman effect being due to the transition from one electronic level to the next. The author discusses here some exceptions to the normal rules of selection for the Raman effect to decide between a molecule and a crystal effect. He thus arrives at an interpretation of the Raman spectra of carbonic anhydride and carbon tetrachloride, the very feeble continuous spectrum of rock-salt, and the Raman spectra of calcite and sodium nitrate. E. E. F. d'A.

259. Quantitative Measurements with the Multiplex Interference Spectroscope. P. Görlich and E. Lau. *Zeits. f. Physik*, 77. 11–12. *pp*. 746–751, *Sept*. 3, 1932.—The authors describe a method for the quantitative analysis of the photographs obtained with a multiplex interference spectroscope, and test the method on four mercury lines. W. S. S.

260. Spectrophotography of "Flash" Sources or of Sources of Low Intensity. W. Kraemer. *Zeits. f. Instrumentenk*. 52. *pp*. 442–446, *Oct*., 1932.—A simple apparatus is described for photographing the spectra of flash sources or of sources of low intensity. The spectrograph, which can be built up on an ordinary optical bench, has a direct vision prism consisting of 5 separate prisms, and a camera taking 4¼ × 6 cm. plates with a triplet objective whose focal length is only 35 mm. The dispersion obtained at $\lambda = 3800$ is 10 Å. per mm. with very good resolution. Wave-lengths are given for a number of lines of neon and iron photographed with the instrument, and the mean deviation from the international values is only 0·3 Å. C. B. A.

261. Sparks for Spectrum Analysis. O. Feussner. *Zeits. f. techn. Physik*, 13. 11. *pp*. 573–575, 1932.—The conditions for exciting an oscillatory discharge by means of a tuned circuit are discussed, in order to obtain sparks for spectrum analysis free from absorption and similar effects shown by a damped discharge. F. S.

See also Abstracts 7, 39, 74, 79, 90, 91, 149, 152, 183, 215, 225, 274, 293, 301, 328, 329, 330.

VISION.

262. Corresponding Retinal Points, the Horopter and Size and Shape of Ocular Images. A. Ames, Jr., K. N. Ogle, and G. H. Gliddon. *J.O.S.A.* 22. *pp*. 538–574, *Oct*., 1932.—Two retinal points, one in each eye, form a pair of corresponding retinal points if the stimulation of either gives the impression of an object in the same direction. The authors discuss the part played by corresponding retinal points in determining the horopter (the surface in space each point of which is imaged at corresponding retinal points in the two eyes), and the size and shape of ocular images. The replacement of corresponding points by corresponding fusion areas is also explained. The second part of the paper describes new apparatus for determining the horopter, (*a*) at distances from 20 cm. to 100 cm., (*b*) at a distance of 6·1 m. The experimental procedure and method of analysing the data are explained, the actual results being postponed for a second paper. W. S. S.

263. Magnification by Corrective Lenses. R. Petit. *Comptes Rendus*, 195. *pp*. 586–587, *Oct*. 3, 1932.—Contrary to common belief, a corrective lens placed at the anterior focus of the eye, produces a slight magnification. For a presbyope viewing an object at 30 cm. through corrective lenses, there is an apparent increase in size of 5 %, or for meniscus lenses, 8 %. The effect is eliminated by using a combination of two lenses separated by an air film, which is such that the emergent nodal point lies in the plane of the eye pupil. The combination can be made to correct at the same time for achromatism, distortion, astigmatism and curvature of field. W. S. S.

X-RAYS.

264. Hot-Kathode X-Ray Tubes for Steady Running. W. R. Harper. *Cambridge Phil. Soc., Proc.* 28. *pp.* 497–508, *Oct.* 31, 1932.—General considerations are given regarding the design of hot-kathode X-ray tubes for the production of constant and repeatable X-ray beams. A tube constructed in accordance with these considerations is described. The estimated input limit is 5 kW, but the tube has not yet been loaded above 1 kW. Except with small tube currents the quality of the vacuum in the tube has little influence on the steadiness of the beam, provided that the electrical input to the tube can be satisfactorily controlled. With this tube an X-ray beam can be maintained constant to within 1 % over a period of several hours, and conditions can be repeated even after a day or more. Points in connection with focussing and the use of an auxiliary electrode are also discussed. J. T.

265. Metal X-Ray Tube for Characteristic Radiation. C. J. Ksanda. *Rev. Sci. Instruments,* 3. 531–534, *Oct.*, 1932.—A gas X-ray tube is described in the design of which no use has been made of soldered parts, ground cone joints or vacuum grease. The main body is of stainless steel, and the various parts of the tube are held together by a series of locknuts. Three aluminium windows are provided. J. T.

266. Atom-Factors. W. Ehrenberg and K. Schäfer. *Phys. Zeits.* 33. *pp.* 575–576, *Aug.* 1, 1932.—Remarks on some of the conclusions derived in a previous paper [see Abstract 2881 (1932)]. A. D.

267. Numerical Values of Atomic Constants and X-Ray Terms. H. R. Robinson. *Phil. Mag.* 14. *pp.* 605–612, *Oct.*, 1932.—A discussion of the present state of the question of evaluation of these constants. There are discrepancies between the results obtained by measurements of the effect of a uniform magnetic field upon the path of a photoelectron and those obtained with the X-ray (crystal) spectrometer. Recent work is discussed, and reference is made to certain experiments and recalculations by the author. A. D.

268. Scattering of X-Rays in Chlorine. H. Richter. *Phys. Zeits.* 33. *pp.* 587–588, *Aug.* 1, 1932.—Gajewski has recently found that diatomic molecules, such as N_2 and O_2, give easily recognisable interferences. Much more so ought Cl_2 to do. The question arises whether the Thomas–Fermi or the Hartree formula best represents the atom-form-factors for Cl_2. Experimental data and curves show that the Hartree formula is quite satisfactory, while the Thomas-Fermi gives results which are wide of the mark. A. D.

269. Scattering of Hard X-Rays by Solids. S. Chylinski. *Phys. Rev.* 42. *pp.* 153–166, *Oct.* 15, 1932.—The distribution of the intensity of scattering for angles ranging from 10° to 105° has been experimentally determined for various solids. For paraffin and Al the scattering occurred at an effective wave-length for the primary rays of 0·23 Å. for Cu and Pb the wave-length was 0·19 Å. These wave-lengths were determined from absorption measurements in Al. The scattering from paraffin and Al was from thin plates by the transmission method, while that from Cu and Pb was from thick plates by reflection. The ratios of intensities at any given angles to those at 90° were corrected for the different ionisation effects at those angles, on account of the change of wave-length due to the Compton effect. Comparison of the experimental results for paraffin with the predictions of the Breit–Dirac theory of scattering from free electrons shows distinct excess scattering. This part of the work has been performed with a precision of about 1 %. In addition, the S-values (scattering per electron) were computed for the various materials from their experimental scattering functions, using the paraffin value at 90°, as predicted by the Dirac theory, as the basic measure. The S-values from aluminium have a most probable error of less than 2 %, while those from Cu and Pb, being based upon a not entirely satisfactory computation, are assigned less than 6 %. Curves have been plotted of the S-values against $[\sin(\phi/2)]/\lambda$. The S-values show a large increase with the atomic number of the scatterer for the smaller values of $[\sin(\phi/2)]/\lambda$, while for the larger values they tend to come together. AUTHOR.

270. Influence of Temperature on the Scattering of X-Rays by Gas-Molecules. R. W. James. *Phys. Zeits.* 33. *pp.* 737–754, *Oct.* 15, 1932.—It appears that while the scattering of X-rays by CCl_4 shows a general agreement with Debye's theory, based upon a tetrahedric molecule-model, there still remain differences, which might be attributed to temperature-oscillations of the atom in the molecule. The influence of temperature was therefore investigated. The scattering-curves of $SiCl_4$ were obtained at 100° C. and at 300° C. by the use of Cu Kα-radiations. Within the limits of experimental error there were no differences between the two curves. The tetrahedric structure of $SiCl_4$ was confirmed, with Cl-Cl distances 3·35 Å. and Si-Cl distances 2·17 Å. The scattering of X-rays by molecules with oscillating atoms is theoretically considered. The theory is extended to the case of diatomic molecules. Shown numerically that the effect of temperature ought to be too small to be observed. The influence of temperature therefore fails as an explanation. [See following Abstract.] A. D.

271. Use of Monochromatic Radiation in X-Ray Scattering by Gases. W. van der Grinten. *Phys. Zeits.* 33. *pp.* 769–770, *Oct.* 15, 1932.—A preliminary note, dealing with the same difficulty as James [see preceding Abstract], and pointing out that the use of strictly monochromatic radiation tends to obliterate the discrepancies. Possible sources for the discrepancies briefly considered. A. D.

272. Absorption Coefficient for X-Rays near L-Edges of Pt and Au. M. Wolf. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 547–550, 1932.—The absolute values of the absorption coefficients for about twenty emission lines near the L-edges of Pt and Au are measured and the change of absorption coefficient at each edge is obtained. From these results the number of dispersion electrons connected with each of the three L-levels is calculated. A similar calculation is carried out for Ag from published data on absorption coefficients at the L-edges of this metal. J. T.

273. Magnitudes of the L-Absorption Discontinuities of Gold. F. M. Uber and C. G. Patten. *Phys. Rev.* 42. *pp.* 229–232, *Oct.* 15, 1932.—Uniform evaporated films of gold have been used in obtaining values for the magnitudes of the L absorption discontinuities and the variations of the absorption coefficients with wave-length. The magnitudes of the discontinuities, where the scattering is considered as negligible, are $\delta_{L_I} = 1 \cdot 16$, $\delta_{L_{II}} = 1 \cdot 39$, $\delta_{L_{III}} = 2 \cdot 48$. These are in good agreement with the values obtained for mercury by one of the authors [see Abstract 3496 (1931)]. Several comparisons are made with the data of other observers. AUTHORS.

See also Abstracts 27, 121.

HEAT.

CALORIMETRY.

274. Specific Heats of Diatomic Gases Using Quantum Statistics. C. Gregory. *Zeits. f. Physik,* 78. 11–12. *pp.* 791–800, *Oct.* 28, 1932.—The specific heat of a diatomic gas is calculated using quantum statistics for the number of molecules in any given state. The deviation of the theoretical term values from those given by the simpler formulæ commonly used are also taken into account. The corrections are evaluated numerically and are in general of the order of a few tenths of 1 %. J. H. A.

275. Total and Specific Heats of a Series of Fractions of Petroleum, and their Relation to Other Properties. Parts IX–XII. H. R. Lang and R. Jessel. *Inst. Petroleum Technologists, J.* 18. *pp.* 850–865, *Oct.,* 1932.—Parts IX, X and XI give results for Venezuelan oil, similar to those previously reported for Miri and Persian oils [see Abstract 514 (1932)]. Five close-cut fractions of the oil were prepared, boiling respectively over the ranges 75–100, 100–125, 125–150, 150–175 and 175–200° C. These were examined for sulphur content, wax content, viscosity, density, refractive index, expansion coefficient, specific heat and total heat. The boiling point varies almost linearly, and the refractive index extremely so, with the specific gravity. The specific heat of each fraction (when free from air) is a linear function of the temperature, but the slopes of the lines vary systematically with the boiling point. At a fixed temperature, the specific heats of the different samples vary smoothly with specific gravity. Part XII summarises the results in the preceding 11 parts. It is pointed out that the specific gravity is not as good an index figure as had previously been supposed, and proposes the refractive index as a second index. The specific refraction $(\mu - 1)/d$ is practically a constant for the fractions from any one source, where μ and d are refractive index and density, both taken at 20° C. It is also noted that the mean molecular weight is proportional to the square of the mean boiling point on the absolute scale. J. H. A.

276. Specific Heat of Liquid Helium. W. H. Keesom and K. Clusius. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 307–320, 1932. *In German. Comm. No.* 219*e from the K. Onnes Lab., Leiden.*—The specific heat of liquid helium under its own saturated vapour pressure was determined from 1·4° to 4·1° K. From 1·4° the curve rises steeply to a maximum at 2·19°, where the atomic heat is about 9 calories, and then falls rapidly to a flat minimum at about 2·6° K. The paper includes an interesting account of the experimental methods and of the necessary corrections, and concludes with a review of the possible theoretical explanations of the experimental results. L. G. C.

277. Anomaly in the Specific Heat of Liquid Helium. W. H. Keesom and (Miss) A. P. Keesom. *K. Akad. Amsterdam, Proc.* 35. 6 *pp.* 736–742, 1932. *Comm. No.* 221*d from the K. Onnes Lab., Leiden.*—The paper records a closer examination of the anomaly in the specific heat of liquid helium [see preceding Abstract], the calorimeter being improved by the introduction of a copper cross which aided heat conduction in the liquid. In the immediate neighbourhood of 2·19° K. the specific heat was measured with very small temperature-rises of the order of 0·01°.

L. G. C.

278. Measurement of the Specific Heat of Silver from 1·35 to 20·3° K. W. H. Keesom and J. A. Kok. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 301–306, 1932. *Comm. No.* 219*d from the K. Onnes Lab., Leiden.*—The atomic heat of silver is measured from 1·35° to 20·3° K., and from the values at various temperatures are calculated the corresponding characteristic temperatures θ. These are approximately constant (θ about 210°) from about 20° to 10° K., rise to a maximum at 5·4° K. ($\theta = 226$) and decrease below this temperature to $\theta = 165$ at 1·35° K. L. G. C.

279. Change in Specific Heat of Tin when Becoming Supraconductive. W. H. Keesom and J. A. Kok. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 743–748, 1932. *Comm. No.* 221*e from the K. Onnes Lab., Leiden.*—Accurate measurements show that the atomic heat of tin falls from 0·0078 to 0·0054 cal./1° K. in the temperature interval 3·70° to 3·62° K. The change is complete within 0·01° K. and agrees with the transition temperature to within 0·01° K. J. H. A.

280. Specific Heats of Metals in the Stabilised and Non-Stabilised Conditions: Platinum, Silver, Copper and Gold. F. M. Jaeger, E. Rosenbohm and J. A. Bottema. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 763–779, 1932.—The authors emphasise the extreme importance of employing thoroughly annealed specimens in specific heat work, if reproducible results, characteristic of the metals themselves, are desired. For platinum, unannealed metal gave specific heats 2 % lower than those of annealed metal, while for silver the curve for annealed metal was found to be concave to the temperature axis, although previous workers, using presumably unannealed specimens, obtained a curve convex to the temperature axis. Copper also shows a difference between the annealed and the unannealed states, the specific heat in the unannealed state being in this case the higher. The effect in gold is not large, the specific heat of unannealed specimens being about ½ % less than that of annealed. L. G. C.

281. Neumann–Joule–Kopp–Regnault Law of Molecular and Atomic Heats. F. M. Jaeger and J. A. Bottema. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 352–362, 1932.—From previous data of other observers and from some new measurements of the authors from air temperature to 220° C. a curve for C_p, the atomic heat of tin at constant volume, has been constructed. C_p for platinum is also known. From these the molecular heat of the compound PtSn is calculated and compared with the authors' experimental values. It is found that the molecular heat of the compound is smaller than that calculated by the Neumann additive rule, the defect being about 4½ % at 20° C. and 9 % at 200° C. L. G. C.

282. Calorimeter Cooling Correction in High-Temperature Calorimetry. F. M. Jaeger, E. Rosenbohm and J. A. Bottema. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 347–352, 1932.—The paper deals with the "leakage modulus" k of a metal block calorimeter, defined by the equation $\log \theta_1 - \log \theta_2 = k(t_2 - t_1)$, where θ_1 and θ_2 denote temperature differences between the block and its environment at times t_1 and t_2, Newton's law of cooling being assumed. With the calorimeter as at first constructed the value of h slowly decreased with time during an experiment. It was found, however, that this could be eliminated and satisfactory operation obtained if the space between the metal block and the inner glass wall of the Dewar flask were filled up with some good conducting material such as graphite and the outer wall of the Dewar flask brought into direct thermal contact with the water in the thermostat jacket. L. G. C.

283. Calorimetric Method for Determining the Intrinsic Energy of a Gas as a Function of the Pressure. E. W. Washburn. *Bureau of Standards, J. of Research,* 9. *pp.* 521–528, *Oct.,* 1932.—The internal energy U of real, as distinct from ideal, gases, is a function of pressure p as well as of temperature T. The quantity $(\partial U/\partial p)_T$ has previously been obtained from an equation of state, or from measurements of the Joule–Thomson coefficient, in which case a correction is required for the change of pv with pressure. A direct calorimetric method is now described, in which a known mass of gas compressed in a bomb is allowed to expand gradually, and the cooling effect is compensated by electrical heating. The energy effect due to change in the material of the bomb under the pressure variation must be considered, but can be reduced to a very small magnitude by suitable design. J. H. A.

See also Abstracts 52, 287, 297, 300.

CONDUCTION.

284. Heat Conduction and Convection from Tall Hot Vertical Cylinders and High Walls at Uniform Temperature. W. S. Kimball and W. J. King. *Phil. Mag.* 14. *pp.* 570–591, *Oct.,* 1932.—An analysis has been given [see Abstract 4395 (1932)] of the heat flow from hot vertical planes less than 2 ft. high. The present theory deals with the theory of the transference of heat from hot high walls and tall cylinders in air. Previously it was assumed that heat transfer took place by pure conduction through gas in stream-line motion. For tall hot vertical bodies the authors base their calculations on the empirical law that above a certain limiting height (beyond which turbulence is presumably established) the rate of heat transfer is constant and equal to the average rate of heat transfer below this limiting height. Theoretical formulæ are then obtained which involve only the known physical constants and the dimensions that occur in the space considered. H. L. B.

285. Temperature Distribution in Solid Bodies during Heating or Cooling. J. B. Austin. *Physics,* 3. *pp.* 179–184, *Oct.,* 1932.—Corrections to solutions of heat-flow problems obtained in a previous paper [see Abstract 4235 (1931)]. G. G. S.

286. Surface Temperatures of Geometrically Simple Bodies. G. Pöschl. *Zeits. f. angew. Math. u. Mechanik.* 12. *pp.* 280–287, *Oct.,* 1932.—By means of a series of diagrams and tables of functions H. Gröber [see Abstract 1922 (1925)] has systematised the calculation of temperatures throughout a number of bodies in which heat transfer proceeds. In this paper the work is extended to the calculation of surface temperatures in spheres, cylinders and plates, for low values of the conductivity and small intervals of time after the commencement of the heat flow. The tables of functions and necessary diagrams are given. J. P. A.

See also Abstracts 287, 312.

CONVECTION.

287. Investigation of the Cooling of Glowing Silit Rods by Photographic Pyrometry. R. Hase. *Zeits. f. techn. Physik,* 13. 9. *pp.* 410–415, 1932.—The velocity of cooling of a hot body is specially interesting during the first few seconds after the source of heat supply is cut off. Technically this plays a part in working iron and metals, as well as in heating and lighting. Physically the velocity of cooling is interesting, as it permits the heat constants of the material to be measured. The photographic difficulties, choice of emulsion, interpolation of blackening of photographic film, etc., are first fully discussed, especially with regard to possible errors, then a formula is given for the solution of Fourier's equations in terms of Gauss integrals from which the velocity of cooling can be calculated. This is found for the first few seconds for three characteristic materials, *i.e.*, nickel, Silit and fireclay, and the heat conductivity, specific heat and specific gravity are given for the three materials. The measurement of the heat conductivity and specific heat in the case of Silit are separately described on account of the growing use of this substance and the lack of details of its properties. T. B.

288. Determination of the Heat Loss from Local Heating Apparatus, Especially Radiators. E. F. M. van der Held and L. L. Mulder. *K. Akad. Amsterdam, Proc.* 35. 2. *pp.* 267–276, *and* 35. 3. *pp.* 426–437, 1932. *In German.*—Full particulars are given of the experimental arrangements employed with a form of hot-water system and radiators, the heat losses by radiation and convection being separated. For the determination of the total heat loss, the cooling method was found to be technically the most useful, and chosen as the test method. To determine the heat loss by convection the air flow is measured by a delicate torsion arrangement. The radiation loss was determined with the help of a constantan-manganin thermoelement, and the results are in agreement with Thomas' formula These cooling experiments give a total heat loss exceeding by 7 % the sum of the losses by radiation and convection, and the difference is ascribed to errors in the convection measurements. R. S. R.

See also Abstract 284.

DILATATION.

See Abstracts 28, 78, 185, 275.

MELTING AND BOILING POINTS.

289. Fusion Curve of Hydrogen up to 610 kg./cm.² W. H. Keesom and J. H. C. Lisman. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 607–610, 1932. *In French. Comm. No.* 221*a from the K. Onnes Lab., Leiden.*—An attempt is made to represent this fusion curve by Simon and Glatzel's formula $\log_{10}(a + p) = c \log_{10} T + b$. The method of least squares gives $a = 245{\cdot}3$, $b = 0{\cdot}28771$, $c = 1{\cdot}83435$. The differences between the observed pressures and those calculated from the formula are systematic, and the formula must be used in combination with a curve giving these differences as a function of the temperature. None of the other formulæ suggested represents the experimental results more satisfactorily. T. H. P.

290. Equation of the Melting Curve. J. J. van Laar. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 624–635, 1932. *In German.*—Simon found the empirical formula $p + a = CT^c$ for the melting curve of He, Ne, Ar, H_2 and N_2. The author deduces the theoretical relation $p + a = BT + CT^{1+c}$ and shows from the example of helium that it agrees well from 20° Abs. to 70° Abs., where Simon's formula rather failed. E. E. F. d'A.

291. Effect of Particle Size of Substances on their Melting Points. N. Schoorl. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 378–380, 1932. *In German.*—Pawlow observed long ago (1909–1910) that small particles of a substance melt in a glass tube at a lower temperature than large pieces. He explained this thermodynamically as due to the difference between the surface energies of the solid and liquid forms changing with the specific surface of the solid. F. Meissner disputes Pawlow's results, and shows that the region in which particle size affects the melting point lies in one of much smaller size than that occurring in Pawlow's experiments. The author agrees with Pawlow's results, but considers that they are to be explained in a different way. He now finds that if Jena glass tubes which have been washed out with water have been employed, no difference between the temperature of melting between the smallest and largest particles can be observed. The difference in behaviour is attributed to the decomposition products (alkali carbonate) from the ordinary glass tubes, which lowers the melting point of fine particles clinging closely to the glass. This point of view was confirmed by experiments with an old and a new glass tube. Another cause for the results obtained by Pawlow might be the want of purity of the substances used. The effect of impurity was tested in the case of benzoin which, when purified, did not show the Pawlow effect, but without purification it did.

T. B.

See also Abstract 275.

TEMPERATURE, MEASUREMENT OF.

292. Adiabatic Method for Precise Electrical Calibration of Thermometers. F. Barry, H. W. Webb and A. K. Smith. *Am. Chem. Soc., J.* 54. *pp.* 3785–3799, *Oct.*, 1932.—The bath used for the calibration is a calorimeter employed adiabatically. Energy is developed electrically at a known and very constant rate. Thus, if the adiabatic condition is accurately maintained, the rate of rise of temperature remains constant to a very high degree of precision. The thermometer is calibrated by noting the times at which the mercury thread crosses the successive graduation marks. For a thermometer divided every 0·01° C. the calibration can be obtained with an exactitude of ±0·0002° C. or less, on a Centigrade scale of equal energy increments. J. H. A.

293. Visual Spectroscopic Method in Heterochromatic Pyrometry. L. S. Ornstein, (Miss) J. G. Eymers and D. Vermeulen. *K. Akad. Amsterdam, Proc.* 35. 3. *pp.* 278–286, 1932.—A double monochromator possesses the advantages of greater spectral purity and greater luminosity. The construction and method of operation of a monochromator pyrometer are described when used in combination with a lamp standardised relatively or absolutely for the visible region. The heterochromatic photometric measurements are made in a quick and accurate way. A description is given of the methods used for (1) relative intensity for a given wave-length, and the results are compared with those with photographic methods; (2) measurement of reflection and absorption;

(3) measurement of the ratio of distant spectral lines; (4) absolute measurement of intensity with results when tested for daylight; (5) determination of the effective wave-length of colour filters in optical pyrometry, thus leading to greater precision in pyrometry; and (6) application to the photometry of incandescent lamps. Differences of brightness of 1 % in red, green and blue can be obtained, and thus the absolute spectral composition for any light source can be found. R. S. R.

294. Micropyrometry. G. Lewin, W. W. Loebe and C. Samson. *Zeits. f. techn. Physik*, 13. 9. *pp*. 415–420, 1932.—To measure the temperature of very small objects, e.g., the filament of an incandescent lamp, a pyrometer with very large magnification is necessary. Commercial pyrometers of this kind either do not magnify sufficiently or require the object to be too close to the objective. These objections have been overcome by Wartenburg and Moehl who, by the use of a very short focus lens, obtained a small image of the glowing object and then observed this with a microscope. Jakob, Loebe and Samson used another method. In this they threw a magnified image on to a screen by means of a microscope projection apparatus. This image was further magnified and observed as in ordinary pyrometry, together with the pyrometer lamp filament, the two being brought to equal brightness. A series of measurements was made in this way, but it was found that owing to fatigue of the eye observations soon became unreliable. To obviate this fatigue Reiter suggested the comparison of the filaments with a photoelectric cell, the cell current being amplified by use of a valve with double grid. The paper gives details of the method, which proved quite satisfactory. T. B.

295. Micropyrometry. G. Lewin. *Zeits. f. techn. Physik*, 13. 10. *pp*. 497–498, 1932.—Briefly outlines principles to be followed in the construction of micropyrometers, and shows how the maximum magnification of a micropyrometer may be increased by the use of a magnesia screen. G. G. S.

296. Modifications in the Haughton–Hanson Thermostat. J. L. Haughton. *Journ. Sci. Instruments*, 9. *pp*. 310–315, *Oct*., 1932.—The paper discusses various improvements in, and additions to, the Haughton–Hanson thermostat [see Abstract 686 (1918)]. The chief of these are: alterations in the design of the U-tube and the "cold-bulb"; methods of obtaining slow heating or cooling, and general layout of the apparatus. AUTHOR.

297. Automatic Regulator for Thermostats or Adiabatic Calorimeters. H. Rieche. *Zeits. f. techn. Physik*, 13. 10. *pp*. 498–499, 1932.—Describes an apparatus, consisting mainly of an a.c. resistance bridge, which can be used as a thermostat or for the automatic regulation of adiabatic calorimeters. G. G. S.

See also Abstracts 66, 79, 286, 287, 328.

THERMOCHEMISTRY.

298. Heat of Formation of Hydrochloric Acid. H. v. Wartenberg and K. Hanisch. *Zeits. f. phys. Chem*. 161, *Abt.A*. 6. *pp*. 463–469, *Oct*., 1932.—It has been frequently suggested that the value 22,000 cal. for the heat of formation of HCl as given by Thomsen is 0·5–0·8 % too high. The authors set themselves the task of settling this uncertainty with the help of modern methods and equipment. The method employed consisted in burning a stream of pure Cl_2 in an atmosphere of pure H_2. Liquid chlorine was supplied from a glass tube, and this was weighed before and after the experiment. The paper describes in detail the form of calorimeter used, and the methods employed to secure and estimate the purity of the Cl_2 and H_2 used. A table of results is given, and as the most probable value from ten experiments, the authors obtained for the heat of formation 21,890 ± 10 cal. T. B.

299. Mechanism of the Initiation and Propagation of Detonation in Solid Explosives. W. Taylor and A. Weale. *Roy. Soc., Proc.* 138. *pp.* 92–116, *Oct.* 1, 1932.—The paper is a description of the preliminary results of a general investigation of the mechanism of detonation in solid explosives, and deals chiefly with the dynamics of the initiation of thin layers of explosives by impulsive forces. The forces are applied by controlled impacts of masses of steel under carefully controlled experimental conditions, and a number of quantitative relations have been obtained relating the criterion of ignition with the mechanical and geometrical factors involved in the impact. The temperature variation of the ignition process is investigated and an exponential relation found which is suggestive of a surface activation mechanism. It is deduced that the characteristic velocity of detonation of a high explosive arises from the balance of two inherent qualities, (*a*) the specific sensitiveness which determines the critical pressure conditions necessary for the initiation of each layer, and (*b*) the velocity of chemical reaction in a layer once initiated under the influence of the critical pressure conditions. The conclusion arrived at as a result of the experimental work is that (*a*) depends upon the tribo-chemical potentialities of the medium, and is affected by a large number of factors which must be determined by experiment. T. B.

300. Specific Heat and Heat of Dissociation of Gases at High Temperatures. K. Wohl and M. Magat. *Zeits. f. phys. Chem.* 19. *Abt. B.* 2–3. *pp.* 117–138, *Oct.*, 1932.—The authors here extend and amplify the previous work of Wohl and Elbe [see Abstract 694 (1930)]. In this work it was found that the heat loss in Nernst's explosion method in the case of a H_2-O_2 explosive mixture was greatly reduced when the reacting gases were saturated with water vapour, without any sensible change in the explosion velocity. The effect of the water vapour is investigated in the present paper, and also the dissociation of H_2O into HO and $\frac{1}{2}H_2$; a knowledge of the dissociation allows a recalculation of the specific heat of N_2. A verification of the specific heat of H_2 is also desirable in view of the extended knowledge of the heat losses in the "explosion method." The explosion method also contributes to the extension of our knowledge of the velocity of exchange between translational and vibrational energy. In the case of N_2 and O_2 the experiments give somewhat low values for the specific heats; this appears to be due to the fact that the explosion time is not of sufficient duration to allow of complete excitation of molecular vibrations. The "water-vapour effect" is confirmed. The most probable value of the heat of dissociation of H_2O into $\frac{1}{2}H_2$ + OH is found to be 62 k.cal. The paper gives many tables of results and equations used in the necessary calculations. T. B.

301. Absorption Spectrum of Nitrous Oxide and Heat of Dissociation of Nitrogen. A. K. Dutta. *Roy. Soc., Proc.* 138. *pp.* 84–91, *Oct.* 1, 1932.—Careful spectrophotometric measurements show that N_2O gas begins to absorb light from λ2750. As the absorption is continuous it can be assumed that the photochemical reaction takes place according to the equation $N_2O + h\nu$ (corresponding to λ2750) $= NO + N$ . . . (1). But from the thermochemical data $N_2O - 17 \cdot 7$ k.cal. $= N_2 + \frac{1}{2}O_2$ . . . (2), and $NO - 21 \cdot 5$ k.cal. $= \frac{1}{2}N_2 + \frac{1}{2}O_2$ . . . (3). From (1), (2) and (3), $N_2 = 2N - 200 \cdot 4$ k.cal., *i.e.*, D_{N_2}, the heat of dissociation of N_2 is 200·4 k.cal., or 8·7 volts. Other methods of evaluating D_{N_2} are reviewed and criticised. T. B.

See also Abstracts 189, 240, 241, 247.

THERMODYNAMICS.

302. Thermodynamics of Concentrated Solutions. Part II. Crystallisation Curves in Binary Eutectic Systems. E. Kordes. *Zeits. f. phys. Chem.* 162. *Abt.A*, 1–2. *pp.* 103–127, *Oct.*, 1932.—Based on earlier work [see Abstract 2166 (1932)] dealing with the position of the eutectic point, an equation is derived whereby the complete crystallisation diagrams of binary eutectic systems may be calculated. The equation contains three constants, two of which may be obtained from normal freezing-point depressions in dilute solutions and heats of fusion, the third being a correction factor due to the positive or negative heat of admixture of the components in the liquid state. The general validity of the new equation is established by a large number of examples, being independent of the nature of the pure components and holding for metals, salts, molecular compounds and even for aqueous solutions. Systems with mixture anomalies in the liquid state may be calculated by the above method.

H. H. Ho.

303. Methane Equilibria from Absolute Entropies, with a Note on the Use of the Ehrenfest Symmetry Number. A. R. Gordon and C. Barnes. *J. Phys. Chem.* 36. *pp.* 2601–2609, *Oct.*, 1932.—The entropy of methane at 298° K. was calculated from spectroscopic data by Giauque, Blue and Overstreet (*Phys. Rev.* 38. p. 196, 1931), who used the Ehrenfest formula which is strictly valid for the rotational entropy at this temperature. A calculation by Villars [see Abstract 917 (1932)], using the rotational symmetry characters of Elert [see Abstract 421 (1929)], gave the same result when corrected for certain numerical errors. The value so obtained for the entropy agreed moderately well with the free energy data derived by Storch [see Abstract 3151 (1931)] from measurements made by Randall and his associates on the two reactions $CH_4 + 2H_2O = CO_2 + 4H_2$ (1) and C(graphite) $+ 2H_2 = CH_4$ (2). A consistent computation, using spectroscopic entropies and heat capacities of the gases, is now made for these reactions, the only other quantities involved being the "third law" entropy of graphite and the calorimetric values of the heats of reaction. The values deduced for reaction (1) are $-\Delta H^{\circ}_{298 \cdot 1} = -39{,}500$, $-\Delta S^{\circ}_{298 \cdot 1} = -41 \cdot 52$, $-\Delta F^{\circ}_{298 \cdot 1} = -27{,}120$ and the value of $-\Delta F^{\circ}_{298 \cdot 1}$ for methane, calculated from the heat of formation and the entropies, is 12,490 cal.; Giauque, Blue and Overstreet's value (*loc. cit.*) is 12,440 cal.

T. H. P.

304. Thermodynamics of Lead Bromide. Jessie Y. Cann and Ruth A. Sumner. *J. Phys. Chem.* 36. *pp.* 2615–2620, *Oct.*, 1932.—The

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free energy of formation, the change of entropy, the change of heat content, and the activity coefficient of lead bromide were determined by means of e.m.f. measurements. The cells employed were of the form: Pb (sat. amalgam), $PbBr_2$ (s), $PbBr_2$ (sat. soln.), KBr (soln), AgBr (s), Ag. The solutions of KBr ranged from 0·025 *N* to 0·1 *N*, and the measurements were carried out over a year. The values obtained for the free energy of formation and the change of heat content agreed well with recorded values. F. J. B.

305. Thermodynamic Studies on Silver Chloride and Silver Bromide. F. L. E. Shibata and T. Taketa. *Hiroshima Journ. Sci.* 2. *pp.* 243–263, *Oct.*, 1932. *In English.*—The e.m.f.s of cells of the type H_2 (Pt)|HCl (0·10003 M) AgCl|Ag were measured in darkness over the temperature range 4° to 30° C. for 800–900 hours, and for the range 20° to 30° C. are represented by the equation

$$E_t = 0 \cdot 35303 - 0 \cdot 000191(t - 25) - 0 \cdot 00000207(t - 25)^2.$$

For the free energy of formation (F), heat of formation (H) of AgCl, and entropy (S), the data obtained were $\Delta F_{298} = -26{,}194$ cal., $\Delta H_{298} = -29{,}852$ cal., $\Delta S = -12 \cdot 3$ cal./deg., $S_{298} = 24 \cdot 3$ cal./deg. Similar investigations were made on cells of the type

$$H_2(Pt)|HBr(0 \cdot 10003M)AgBr|Ag.$$

From the e.m.f.-temperature curve it was concluded that AgBr has three modifications in the range 5° to 30° C., giving two transition points at 15·9° and 21·5° C. The corresponding equation, in the temperature-range 22·5° to 30° C., and data for AgBr, are $\Delta F_{298} = -22{,}915$ cal., $\Delta H_{298} = -23{,}432$ cal., $\Delta S = -1 \cdot 73$ cal./deg., $S_{298} = 26 \cdot 9$ cal./deg. The difference of properties of the two halides caused by the light effects on the cells is briefly discussed. N. M. B.

306. Overstepping of Potential Thresholds in Chemical Reactions. E. Wigner. *Zeits. f. phys. Chem.* 19. *Abt. B.* 2–3. *pp.* 203–216, *Oct.*, 1932.—The overstepping of a potential threshold is calculated by means of Maxwell's velocity distribution for the case where the quantum correction is only considered as far as terms involving the second power of the Planck constant. The result is compared with Eckart's exact calculation for exceeding a definite potential threshold, and is applied to the transformation velocity of para-hydrogen into normal hydrogen. H. H. Ho.

See also Abstracts 42, 44, 99, 110, 283, 368.

VAPOUR PRESSURE.

307. Vapour-Pressure of Sodium. E. Thiele. *Ann. d. Physik*, 14. 8. *pp.* 937–970, *Oct.*, 1932.—Commences with an account of earlier data on the vapour-pressure of sodium. Describes a sensitive flow method, using vacuum-distilled sodium between 614° and 771° Abs. Revised formulæ are given for the vapour-pressures of the sodium atom and of the diatomic sodium molecule. The heat of evaporation of the sodium atom at absolute zero is given as 26,200 ± 130 cal., and the chemical constant as 0·85 ± 0·10. [See Abstract 2970 (1930).] G. G. S.

See also Abstracts 1, 222.

ACOUSTICS.

308. Accession to Inertia of Flexible Discs Vibrating in a Fluid. N. W. McLachlan. *Phys. Soc., Proc.* **44.** *pp.* **546–555,** *Sept.* **1, 1932.**—In this paper formulæ are obtained for the velocity-potential at the surface of a free-edge disc vibrating with nodal lines in a fluid. These formulæ are used to ascertain the accession to inertia due to the fluid when the disc is set in an infinite rigid plane. The equivalent mass and the mass coefficient of the disc vibrating *in vacuo* are also found. By means of these results, the influence of the fluid on the frequency of vibrations with (*a*) one nodal circle, (*b*) one nodal diameter, (*c*) stationary centre, is evaluated. In air the alteration in frequency is almost negligible, whereas in water the frequency is reduced to a small fraction of its value *in vacuo*. AUTHOR.

309. Axial Sound-Pressure Due to Diaphragms with Nodal Lines. N. W. McLachlan. *Phys. Soc., Proc.* 44. *pp.* 540–545, *Sept.* 1, 1932.—A formula is found for the axial sound-pressure due to a disc having a nodal circle and vibrating in an infinite rigid plane. Beyond a certain axial distance, when the nodal circle occurs at $r = a/\sqrt{2}$, the pressure vanishes owing to interference caused by the inner and outer portions of the disc vibrating in opposite phase. The case of n nodal circles of arbitrary radii is treated by an approximate method. A rigid disc is imagined to be severed around each nodal circle, whilst contiguous annuli vibrate with equal amplitudes in opposite phases. Finally, the pressure on the axis of a conical shell having nodal circles is treated as in the previous case. When the semi-apical angle of the cone is $\frac{\pi}{2}$ and there are no nodal circles, the formula reduces to that for a rigid disc. AUTHOR.

310. Electrodynamic Membrane "Drive." H. Benecke. *E.N.T.* 9. *pp.* 382–387, *Oct.*, 1932.—The question of the design of the moving coil used to drive a loud-speaker diaphragm is considered mathematically. The usual assumption that the mass of the coil should be equal to that of the diaphragm to obtain the best results is not found to be valid. An expression is derived for the optimum mass of the coil. Departures from this optimum value have little effect in the middle frequency range, but their effect is much greater near the limits of the frequency range. A. W.

311. Modes of Vibration of a Conical Membrane. H. Benecke. *Zeits. f. techn. Physik,* 13. 10. *pp.* 481–483, 1932.—Chladni figures on a vibrating conical membrane of angle 105° are secured by strewing sand on the surface, and rotating the cone about its axis at a suitable speed. A camera, rotating with the cone, records the appearance of the figures, five of which are shown. J. P. A.

312. Ultrasonic Waves. P. Biquard. *Rev. d'Acoustique,* 1. *pp.* 93–109, *May,* 1932.—A mathematical account of plane wave motion deriving from first principles expressions for the energy transmission associated with a sound wave and the decay of amplitude with distance due to viscosity and heat conduction. At 10° C. and a frequency of 160,000 c.p.s., the effect of conduction on damping is, for water, 7000 times less than the effect of viscosity; whereas for air it is only three times less. The paper concludes with Langevin's deduction of the fact that the pressure exerted by sound radiation is equal to the energy density of that radiation. E. J. I.

313. Effect of Humidity on the Velocity of Supersonic Waves in Air. M. Kinoshita and C. Ishii. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 384. *pp.* 83–96, *Oct.*, 1932. *In English.*—The velocity V of waves, sonic or supersonic, in a real gas is calculated as $V = \sqrt{\frac{p}{\rho}\frac{\beta}{\alpha}\gamma}$, where p is the pressure, ρ the density, α the expansion coefficient, β the pressure coefficient and γ the ratio of the specific heats. Treating both the air and the water vapour as real gases, V_h, the velocity in humid air, becomes $V_h = V_1(1 + 0{\cdot}000210e)$, where V_1 is the velocity in dry air and e the vapour tension in mm. Hg. The experimental result in the supersonic range, however, gave $V_h = V_1\{1 + (0{\cdot}00023 \pm 0{\cdot}00001)e\}$. An application of this relation to practical hygrometry is suggested. AUTHORS.

314. Quasi-Standing Waves in a Dispersive Gas. D. G. Bourgin. *Acoustical Soc. of America, J.* 4. *pp.* 108–111, *Oct.*, 1932.—A theoretical investigation into the positions of the " nodes " in a semi-stationary wave formed by a h.f. source in an absorbing gas. E. J. I.

315. Detector for H.F. Sounds. H. Kröncke. *Phys. Zeits.* 33. *pp.* 733–734, *Oct.* 1, 1932.—A resonance detector for h.f. sounds is made from a short glass tube sealed at both ends, and containing a little dry sand. The tube, when excited by resonance, vibrates in four segments with nodes and antinodes parallel to its axis. J. P. A.

316. Noises in Amplifiers of Photoelectric Cells. F. v. Orbán. *Zeits. f. techn. Physik,* 13. 9. *pp.* 420–424, 1932.—With high amplification the two unavoidable sources of noise are the small-shot effect or Schottky effect and the noise due to Brownian motion or thermal agitation of the charged particles. The author measures and records these noises, and shows that they diminish as the damping increases. E. E. F. d'A.

317. Analysis of Aircraft Noises. F. Eisner, H. Rehm and H. Schuchmann. *E.N.T.* 9. *pp.* 323–333, *Sept.*, 1932.—Methods hitherto employed in analysing noise frequencies are shortly reviewed. The authors, using a search-tone method, record the noise spectra for aircraft and motors, on the ground and in flight. In connection with this a new analyser circuit with rectifiers is used, and its efficiency is investigated. The resolving power of the method is assessed at 100 cycles. From the tests of aircraft on the ground and in flight, in which sound records were obtained for positions outside the aeroplane, under the deck, in the cabin and in the pilot's seat, it is found that the frequency spectrum contains chiefly partial-tones between 100 and 1000 cycles. The testing stand also gave partials of considerable amplitude up to several thousand cycles. G. E. A.

318. Noise Emitted by Revolving Airscrews. J. Obata, S. Morita and Y. Yosida. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 399–417, *Sept.*, 1932. *In English.*—The sound emitted from two two-bladed propellers is recorded by an oscillograph and then analysed. The propellers were driven electrically at a speed of about 1850 r.p.m. A number of oscillograms and analyses are reproduced, and the following deductions are made: In general, there are two principal frequencies present, and these are approximately equally loud. The upper frequency is given as being approximately 2600, but it is rather indefinite. The lower frequency equals the number of revolutions per sec. multiplied by the number of blades upon the propeller. Measurements of the total loudness were made with an audiometer, and show that the loudness in decibels bears a linear relationship to the speed. The loudness falls off with distance more rapidly than would be expected from the inverse square law. At high rotational speeds, the sound is stated to be fairly uniformly distributed in all directions. [See also Abstract 3359 (1932) and following Abstract.] J. E. R. C.

319. Noise Emitted from Model Airscrews. J. Obata, Y. Yosida and S. Morita. *Tokyo Univ. Aeronaut. Research Inst., Report,* 6. 80. *pp.* 389–440, *July,* 1932. *In English.*—In a previous paper [see preceding Abstract] the noise emitted by full-size airscrews has been studied. The authors now investigate the noise emitted by model airscrews built to various scales. By using a low-pass filter only the fundamental note was investigated. All the airscrews were two-bladed, and consisted of Reed metal, wooden and Karman types. They were driven by an electric motor placed in a sound-proof box, and the sound was picked up by a condenser microphone and was measured in various directions. As in the previous paper, the sound amplitude was recorded by an oscillograph, and the records were afterwards analysed. The polar distribution was found to be a function of the type of propeller, and in the case of the Reed type the fundamental is only conspicuous in the plane of rotation. The effect of varying the pitch of the blades was investigated. As in the previous paper a linear relationship was found to exist between the rotational speed and the sensation level of the fundamental tone. The sensation level is found to vary exponentially with the pitch angle. It is noted that in these experiments the propeller was backed by a hard wall and was near the ground, so that the polar curves are liable to error. A large number of oscillograms and their analyses are reproduced. J. E. R. C.

320. Accuracy of the Aural Method of Measuring Noises. J. Obata and S. Morita. *Acoustical Soc. of America, J.* 4. *pp.* 129–137, *Oct.,* 1932.—A critical comparison of the results of noise measurements made on a Tôkyô suburban railway by aural estimations (using Siemens and Halske type instruments and Western audiometers) and by indicating noise meters consisting of microphone, amplifier and milliammeter. Various instrumental and subjective errors are examined and it is concluded that careful aural measurements are significant. E. J. I.

321. Absolute Measurement of Fundamental Quantities in Sound. Z. Carrière. *Rev. d'Acoustique,* 1. *pp.* 28–51, *March, and pp.* 110–125, *May,* 1932.—A detailed, informative and critical discussion of various methods for measuring frequency (mainly stroboscopic); amplitude (by observation of light dust particles); and maximum particle velocity and pressure variation. E. J. I.

See also Abstract 152.

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ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstract 393.

CONDUCTION AND DISCHARGE IN GASES.

322. Gas Discharges with Two Different Negative Characteristics. F. M. Penning. *Phys. Zeits.* 33. *pp.* 816–822, *Nov.* 1, 1932. *Zeits. f. techn. Physik,* 13. 11. *pp.* 577–579, 1932.—In discharges in He between parallel plane electrodes the Paschen ignition potential curve (ignition potential V_z as a function of gas pressure $p \times$ electrode distance d) exhibits a peculiar behaviour. For small values of pd the curve has a minimum with respect to the pd axis, so that in a certain region of pd values three different ignition potentials occur. In this region the characteristics are peculiar. With an electrode distance of 3·45 cm. a normal curve is obtained, but with smaller values of d the characteristic divides into two branches, each of which has a negative portion. This effect is discussed from the viewpoint of Kaufmann's criterion for d.c. stability. A general criterion for d.c. stability is then developed and applied to the consideration of any combination of two simple resistances. A. W.

323. Electric Sparks. Part III. T. Kobayasi. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 418–429, *Sept.,* 1932. *In English.*—In an earlier paper the author has shown that the formation of a spark is greatly influenced by the volume charge in the spark-gap before the discharge [see Abstract 2077 (1932)]. The manner of inducing this charge is investigated by causing a discharge to pass across a photographically sensitive plate and observing the figures produced. From the appearance of the glow which surrounds the electrode it is deduced that negative charge streams into the gap between the electrodes. The relationship between the sparking potential and the distance between a pair of spherical electrodes is determined with some care, and an abbreviated table of results is given. The field at any point between the poles is calculated by the method of images, and it is shown that the field at the centre of the gap varies widely with the dimensions of the gap. Hence it is deduced that the field near the electrodes is the controlling factor. By plotting the field when the sparking potential is applied against the distance from the electrode it is shown that the curves obtained for different electrode dimensions converge at a point corresponding to 2·2 mm. from the electrode. At this point the field is 32 kV/cm. It is deduced that this is a condition for a spark to pass for any size of electrode. By plotting the r.m.s. electric field against the distance from the pole it is again found that all curves converge, this time at 8·5 mm. from the electrode. At this point the field is 28·5 kV/cm. It is deduced that a spark will pass when the electric field in a part of the gap 8·5 mm. in length rises as high as 28·5 kV/cm. This derives some confirmation from the appearance of some sparks which have been photographed by the author. J. E. R. C.

324. High Current-Density Glow Discharge at Atmospheric Pressure. H. Thoma and L. Heer. *Zeits. f. techn. Physik,* 13. 10. *pp.* 464–470, 1932.—The glow discharge between plane parallel circular copper electrodes in a special form of discharge tube is first described. The current is proportional to the pressure from 5 to 20 mm. of Hg. It is estimated that the current strength at atmospheric pressure would be about 10 amperes/cm^2, a value considerably below 50 amperes/cm^2 predicted theoretically by Rogowski [see Abstract **564** (1932)]. The discrepancy is considered to be due to the difficulty of control of the temperature of the electrodes. Experiments are made on the glow discharge between spherical electrodes open to the atmosphere. The current is about 1 ampere for a potential difference of about 1000 volts and an electrode separation of about 100 mm. At larger current densities the glow discharge becomes an arc, the blue light of the discharge giving way to the characteristic green of copper vapour. The appearance of the various regions of the discharge are described in detail. Maintaining atmospheric pressure, sets of values are obtained for the variation of potential with varying electrode distances and for different currents from 0·15 to 0·6 ampere. The change from glow discharge to arc is found to depend largely on the state of the surface of the electrodes. Microphotographs of the electrodes are taken before and after discharge. Chemical action in the discharge is very intense, and it is estimated that 1 kg. of HNO_3 is produced per 12 kW. Results are also given for the glow discharge through hydrogen and various hydrogen-methane mixtures at atmospheric pressure. F. C. C.

325. Electric Currents from Glowing Kathodes in Gases and Vapours at Atmospheric Pressure. M. Ruhnke. *Ann. d. Physik*, 14. 8. *pp*. 881–904, *Oct*., **1932**.—The currents from tungsten kathodes in gases and vapours at atmospheric pressure were investigated and relations found for the dependence of the currents on electrode potential, electrode distance, kathode temperature and the nature of the gas. Measurement in Hg vapour, obtained by local heating of Hg at the bottom of the discharge tube, were only qualitative. They show that with the building up of space charges currents may pass between the electrodes accompanied by no ionisation or only weak ionisation. The currents in H_2 were investigated for four different temperatures of the kathode and four different anode diameters at potentials rising to high values. The current-potential curves show three sections: at low potentials a steep rise, probably corresponding to a space-charge characteristic; then a flat part indicating saturation and finally, at higher potentials, a steeper portion due to partial ionisation. Measurements in H_2 with electrode systems including a grid gave evidence of definite ionisation. At high kathode temperatures and relatively low anode potentials the anode current obtained on first application of the field was appreciably greater than the steady final current. Measurements were also made on mixtures of N_2 with a little H_2. Other things being equal, the currents in these mixtures were less than in H_2 but the shape of the curves was similar to that of the H_2 curves. In the case of Hg vapour the tendency of the discharge to pass over to the arc discharge was very pronounced, but in H_2 even at high potentials the tendency to pass to the glow or arc discharge was very small. A. W.

326. Mobility of Alkali Ions in Gases. C. F. Powell and L. Brata. *Roy. Soc., Proc.* 138. *pp*. 117–132, *Oct*. 1, **1932**.—Using the four-gauze method, previous work on the determination of the mobilities of the ions of the four alkali metals, Na, K, Rb and Cs in the rare gases, He, Ne and A, is completed by measurements in Kr and Xe. The method is extended to Li ions. The results in A, Kr and Xe are expressed approximately by the relation $k = 0{\cdot}55/\{\rho(D - 1)\}^{\frac{1}{2}} . (1 + m/M)^{\frac{1}{2}}$ cm./sec./unit e.s. field, where ρ is the density of the gas at N.T.P., D is the dielectric constant, m is the mass of the gas atom and M the mass of the ion. Replacement of the factor 0·55 by a term A makes the above relation identical with two formulæ, (1) Langevin's formula based on an elastic sphere model, (2) Hassé's formula based on a point centre of force model. When polarisation forces predominate, A tends to the limiting value 0·51 in both cases. Similar experiments are made in nitrogen and in hydrogen. When traces of polar impurities are present the original alkali atoms become clustered. The ions formed by the addition of one, two and three molecules of NH_3 can be identified by their mobility and a quantitative study of the growth of clustered ions becomes possible. The method is applied to the search for the element 87 (eka cæsium), with negative results. F. C. C.

327. Effect of Humidity and Temperature on Discharge Characteristics of Electrical Precipitators. S. P. Zebrowski. *Phys. Zeits.* 33. *pp.* 727–729, *Oct.* 1, 1932.—A small precipitator of the type with a central wire lying axially in a cylinder was used, and dust-free air of known humidity fed into it. The dependence of the current on humidity, temperature and air velocity was systematically investigated, at constant pressure. This current increases rapidly with voltage and with temperature. At constant voltage, the current decreases as the absolute humidity increases, the relation being linear in most cases. J. H. A.

328. Optical Determination of Temperature in Discharge Tubes. L. S. Ornstein and P. J. Haringhuizen. *Zeits. f. Physik,* 77. 11–12. *pp.* 788–791, *Sept.* 3, 1932.—The authors determined the temperature in a mercury discharge tube for different pressures of mercury vapour and for various current densities. The method used to find the temperature was to introduce nitrogen at a pressure of 1 mm. into the discharge tube and to measure by photographic photometry the intensity distribution in the rotation band 3998 of the nitrogen spectrum. For mercury vapour pressures from 0·18 to 0·023 mm. the temperature was independent of the current density and varied linearly with the pressure. W. S. S.

329. Cold Electric Arc in Vacuum. F. H. Newman. *Phil. Mag.* 14. *pp.* 712–718, *Oct.*, 1932.—Using the author's method [see Abstract 1378 (1927)] for starting and maintaining a " cold arc " with different electrodes, investigations are made with K, Na and Hg kathodes. Iron anodes are used and the pressure of the gas present, which is mainly hydrogen, is about 10^{-2} mm. of mercury. No external heat is supplied, so that the vapour pressure of the arc electrode is initially that corresponding to room-temperature. The general behaviour of the arcs is described; in particular, the voltage across the arc is found to remain constant for wide variations in the current density (1 to 10 amperes). Two sets of spectrograms are obtained, one in which the arc passed only momentarily so that the temperature remained sensibly constant, and the other after the arc had been passing for some time. In agreement with expectation, the former showed the lines of the residual gases and the latter only the metallic lines. [See following Abstract.] F. C. C.

330. Spectroscopic Examination of Metal Electrodes in Vacuum Arcs. F. H. Newman. *Phil. Mag.* 14. *pp.* 718–725, *Oct.*, 1932.—Using the method described [see preceding Abstract], spectrograms are taken of the radiations from the kathode spot, the kathode glow and the anode glow respectively; the photographic exposure is for 3 sec. from the commencement of the arc. General considerations, and especially the presence of hydrogen lines when the total fall of potential across the arc and also its temperature are insufficient for their excitation, are considered to support the " high field " theory of cold kathode arcs. F. C. C.

331. Collisions of the First and Second Kinds in the Positive Column of a Cæsium Discharge. F. L. Mohler. *Bureau of Standards, J. of Research,* 9. *pp.* 493–508, *Oct.,* 1932.—In a previous paper [see Abstract 4530 (1932)] an account was given of measurements of power input and power losses in the positive column of a cæsium discharge. In the present paper these results are used as a basis for a study of the atomic processes involved in the dissipation of power. The power input minus the power lost by recombination at the tube walls measures the number of quanta dissipated by inelastic collisions at the resonance potential, 1·42 volts. For low-pressure, low-current conditions this is equal to the number of collisions C_{12} and the effective area for a collision is found to be $q_{12} = 5 \cdot 4 \pm 0 \cdot 6 \times 10^{-15}$ cm.² At higher pressures and currents collisions of the second kind give energy back to the electrons and the number of quanta dissipated is $C_{12} - C_{21}$, where C_{21} is the number of collisions of the second kind. This gives a basis for computing the number n_2 of excited atoms. The value of n_2 can also be measured spectroscopically by analysing light from an incandescent lamp passed through the discharge and finding the lamp temperature T_L at which absorption lines match the background. T_L is nearly the electron temperature, confirming the evidence that collisions of the first and second kind become nearly equal in number. The measured radiation intensity is equated to the radiation at a temperature T_L over a spectrum range $\Delta\lambda$ to find $\Delta\lambda$. The effective width of the resonance lines ranges from 0·6 to 19 Å. between 0·006 and 0·35 mm. pressure. At constant pressure the radiation is proportional to n_2 and the ratio gives the depth of the layer of vapour from which the radiation comes: 0·003 to 0·001 mm. in the above pressure range. The studies of Kopfermann and Ladenburg of anomalous dispersion in the neon positive column and deductions from Killian's measurements in the mercury positive column indicate that the relation between the number of excited atoms and the electron temperature are qualitatively similar for Ne, Hg and Cs. These atoms are extremely different in structure and one can conclude that the relation is quite general. While the approach to equilibrium concentration occurs at low current for the first excited state (or close group of states) it requires high currents to approach equilibrium in the second states. Thus there is no reason to expect a distribution of intensity in the line spectrum (in a series of lines, for instance) that is simply related to the electron temperature. A. W.

332. Potential Gradient in the Positive Column of a Mercury-Vapour Discharge. W. Elenbaas. *Zeits. f. Physik,* 78. 9–10. *pp.* 603–608, *Oct.* 18, 1932.—Measurements were made at 100° C. of the potential gradient in the positive column of a discharge through mercury vapour, as dependent on the diameter and on the current strength. The results show that the gradient G is given by the formula $G = C/D^a \cdot i^b$, where D is the diameter and i the current strength, C, a and b being constants. At 100° C. the values of C, a and b were found to be 1·045, 0·69 and 0·12, respectively, G being in volts/cm., D in cm. and i in amperes. For other temperatures the constants were less accurately determined. With increasing temperature, b and C also increase, while a decreases. A. W.

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333. Ionisation of Helium, Neon and Argon Under Impact of Their Own Atoms and Positive Ions. C. J. Brasefield. *Phys. Rev.* 42. *pp.* 11–16, *Oct.* 1, 1932.—The number of electrons liberated from neutral rare gas atoms under impact of their own atoms and positive ions was measured as a function of the kinetic energy of the impinging particles. When the impinging beam is composed mostly of neutral atoms, it is found that helium is ionised at about 60 equivalent volts, neon at about 50 volts and argon at about 40 volts. If the impinging beam is composed of atoms and positive ions in about equal proportions, additional ionisation is found to set in in argon at around 330 volts. No ionisation by positive ions was observed in either helium or neon up to 500 volts. Curves are shown which indicate the efficiency of ionisation of the rare gases under impacts of their own atoms and positive ions. AUTHOR.

334. Flexible Kathode Rays. E. Brüche. *Zeits. f. Physik,* 78. 3–4. *pp.* 177–195, *Sept.* 21, 1932.—Besides being bent by magnetic and electric fields, kathode rays are capable of being bent or conducted along a tube, just as light rays are guided by the walls of a bent glass rod. In hydrogen at a pressure of 5 mm. a beam of kathode rays was conducted without sensible loss through a straight metallic tube 30 cm. long and 2·5 mm. wide. The flow of electrons is not notably diminished by bending the tube through as much as 90°, nor is it much disturbed by magnetic fields. The author bases a provisional explanation upon the positive space charge created by the beam. He estimates the potential existing between the axis of the beam and the metal tube to be about 10 volts. E. E. F. d'A.

335. Electron Microscope. M. Knoll and E. Ruska. *Zeits. f. Physik,* 78. 5–6. *pp.* 318–339, *Oct.* 4, 1932.—The most important electron optical systems of forming pictures and their suitability for making enlarged pictures of electron-emitting objects are discussed. The general conditions for pictures free from error, for definition and capacity of analysis, are given. A description is given of a magnetic electron microscope with cold kathode for swift electrons and also details of the performance of magnetic lenses. Several micro-photographs are reproduced. The methods of investigation with the electron microscope and suitable systems of picture-making for the ionic microscope are mentioned. [See following Abstract.] J. J. S.

336. Emission Distribution at Glow Kathodes with the Magnetic Electron Microscope. M. Knoll, F. G. Houtermans and W. Schulze. *Zeits. f. Physik,* 78. 5–6. *pp.* 340–362, *Oct.* 4, 1932.—A magnetic electron microscope for investigation of electron-emitting substances and its practical application are described. The geometrical similarity of the electron pictures to the object is proved and the distribution of emission of varied kind according to various processes employed and to variously treated oxide kathodes are reproduced in micro-photographs. It is shown that at places of strong emission (insulated glow spots) in front of the kathode, regions of negative space charge (electron clouds) can be directly observed. The phenomena thus manifested are explained, and some of the resulting consequences for the current-voltage characteristic curve for oxide kathodes are referred to. [See Abstract 2557 (1932) and preceding Abstract.] J. J. S.

337. Heterogeneous Chemical Reactions in the Silent Electric Discharge. Part I. S. Miyamoto [with T. Takakura]. *Hiroshima Journ. Sci.* 2. *pp.* 217–242, *Oct.,* 1932. *In English.*—The influence of the silent electric discharge on the reaction between hydrogen and various elements, oxides and metallic salts is studied. Typical reductions which occur are those of sulphur to hydrogen sulphide, cupric to cuprous chloride, cuprous chloride to copper, sodium nitrate to nitrite, ferricyanide to ferrocyanide, chlorate to chloride, arsenic pentoxide to arsenic and arsine, and copper sulphate to copper sulphide, copper and sulphur dioxide.

H. F. G.

338. Kathode-Ray Oscillograph: Direct Records on Photographic Paper. W. Förster. *Zeits. f. techn. Physik,* 13. 8. *pp.* 373–374, 1932.—Commercial contrasty bromide papers may be employed for direct recording in the vacuum space, if the latter has a large volume and is continuously pumped (to remove water vapour, etc., liberated by the paper). This gives a direct black-on-white record, obtained otherwise only *via* two contact printing processes. L. V. C.

339. Low-Speed Braun Tube. G. Dobke. *Zeits. f. techn. Physik,* 13. 9. *pp.* 432–436, 1932.—Describes a Braun tube devised by the A.E.G. research department. It has a zinc silicate or calcium tungstate screen deposited straight on to the glass. The beam is concentrated by the admixture of mercury vapour, which produces much less diffuse illumination than argon. The sensitiveness is about 1 mm./volt. The life of this kind of tube runs into thousands of hours. E. E. F. d'A.

340. Possible Use of Very High Potentials in Discharge Tubes. M. Sitnikov. *Zeits. f. techn. Physik,* 13. 10. *pp.* 460–464, 1932.—The need for an extremely high vacuum is emphasised, and an " electron pump " in the form of a stream of electrons is suggested to replace the ordinary pump due to a stream of Hg molecules. The " electron pump " ionises the remaining gas molecules, the ions then being removed by an electric field. The disadvantages of a rectilinear arrangement of the successive parts of a long discharge tube are contrasted with the advantages of a series of parts arranged in zigzag formation. Magnetic deflection is used at the bends. The method eliminates the slow electrons produced and thus avoids increase of ionisation by collision; it also impresses homogeneity of velocity on the stream of electrons or ions. For the magnetic fields to be effective and of practicable magnitude, the angles of the bends must be made successively smaller. Modifications to be introduced by the use of a.c. potentials are indicated. Finally, it is shown that the rectilinear system of tubes may be maintained if magnetic filters are placed at intervals. The filters consist, in the simplest form, of two closely succeeding magnetic fields, equal in magnitude but opposed in direction. Electrons of velocities less than a certain limit are eliminated by deflection in the first field, but electrons with velocities greater than the limit are redeflected into a continuation of their original path. F. C. C.

341. Valve Amplifier for Feeble Pulses. L. F. Curtiss. *Bureau of Standards, J. of Research,* 9. *pp.* 115–129, *Aug.,* 1932.—A resistance-capacity coupled 5-stage amplifier is described which is suitable for automatic registration of the primary ionisation pulses produced when corpuscular rays pass through a shallow ionisation chamber. A discussion of an improved type of ionisation chamber is given. AUTHOR.

See also Abstracts 130, 214, 230, 235, 399.

CONDUCTION IN SOLIDS AND LIQUIDS.

342. Resistance and Points of Contact. L. Binder. *Zeits. f. techn. Physik,* 13. 9. *pp.* 442–443, 1932.—The resistance between two metallic surfaces in contact decreases with increasing pressure. This decrease is not entirely accounted for by an increase in the number of points of contact. Experiments show that it is largely due to a reduction in the length of stream lines and increase in their sectional area.
E. E. F. d'A.

343. A.C. Rectification by Photosensitive Crystalline Aggregates. G. P. Barnard. *Am. Electrochem. Soc., Trans.* 61. *pp.* 499–510; *Disc.,* 510–513, 1932.—The paper draws attention to the objections advanced against the Eccles thermoelectric theory of the rectification of small current by the crystal-contact detector, with point and plate electrodes, used for the reception of wireless broadcasts. The significance of the association with these crystalline masses of the following properties is emphasised: (1) the dependence of the resistance upon the value of the applied voltage and, in some cases, unipolarity of conduction; (2) a large negative temperature coefficient of electrical resistance; and (3) photoelectric conduction. A new theory is evolved, which is based upon considerations of the crystalline structure and of the mode of conduction of electric charges through these aggregates. The view is expressed that at present it is scarcely possible to deduce theoretically any precise relations between the current obtained and the voltage applied. E. E. F. d'A.

344. Theory of Supraconductivity. R. de L. Kronig. *Zeits. f. Physik,* 78. 11–12. *pp.* 744–750, *Oct.* 28, 1932.—The author discusses in general terms a new model for a metallic conductor, which shall exhibit the characteristic features of supraconductivity. At the absolute zero and at very low temperatures the conduction electrons are imagined to form a rigid lattice of the same form and dimensions as the positive ion lattice. The rigidity of the electron lattice and the restriction of its motion to simple translation without deformation which results in the phenomenon of supraconductivity, are explained by quantum theory considerations. When a certain temperature is reached, the electron lattice is pictured as breaking up and passing into the "liquid" state just as an ordinary solid, the fusion temperature corresponding to the critical temperature at which supraconductivity ceases. A quantitative development of the theory is to follow. W. S. S.

345. Supraconductivity of Gold-Bismuth. W. J. de Haas and T. Jurriaanse. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 748–750, 1932. *Comm. No. 220e from the K. Onnes Lab., Leiden.*—It is shown that the gold-bismuth system contains a third phase, besides the two already known (pure Bi and a solid solution of Bi in Au). This has the analysis Au_2Bi, and this compound is responsible for the supraconductivity which sets in, 0·8° K. above the transition point of gold. Pure Au_2Bi becomes supraconducting at the same point as the eutectic mixture. It crystallises in a face-centred cubic lattice with 24 atoms per elementary cell, the edge being 7·94 Å. in length. J. H. A.

346. Supraconductivity with H.F. Alternating Currents. J. C. McLennan, A. C. Burton, A. Pitt and J. O. Wilhelm. *Roy. Soc., Proc.* 138. *pp.* 245–258, *Oct.* 1, 1932.—In continuation of the previous work [see Abstract 3876 (1932)], the resistance of metals to d.c., both with and without accompanying h.f. current, and to h.f. current with and without accompanying d.c., has been measured. When both types of current are flowing the critical temperature for the h.f. resistance is the same as that for the d.c. resistance, but the actual temperature varies with the ratio of h.f. to d.c. Thus two effects must be recognised, *viz.*, the depression of the d.c. critical point by application of h.f. current and the raising of the h.f. critical point by d.c. Although the alloy 58 % bismuth, 42 % lead exhibits a very sharp transition to supraconductivity, the frequency effect is small. Experiments with h.f. currents of $30 \cdot 3 \times 10^6 \sim$ indicate that for tantalum, as for tin, a frequency of about 10^9 would correspond with a critical point of 0° Abs. H. F. G.

347. Electrical Conduction of Oxygen Occluded by Palladium. D. P. Smith. *Zeits. f. Physik*, 78. 11–12. *pp.* 815–825, *Oct.* 28, 1932.—Experiments are described which provide verification of a previous assertion [see Abstract 3183 (1931)] to the effect that the O_2 occluded in a Pd anode shows characteristic electrical conductivity in addition to that of the metal. In a note **A. Coehn** maintains that no proof is given by Smith that the occluded O_2 takes part in the conduction of Pd. J. E. K.

348. Conductivity of Aqueous Mixtures of Hydrogen Peroxide and Organic Acids. W. H. Hatcher and E. C. Powell. *Canad. J. of Research*, 7. *pp.* 270–284, *Sept.*, 1932.—The conductivities of formic, acetic, propionic and succinic acids and succinic monoperacid have been studied in water and in aqueous H_2O_2 solution. These acids all add H_2O_2 to form unionised complexes which later, with time, lose water to form the so-called peracids of negligible conductivity. The formation of such complexes is dependent solely on the concentration of reagents, the peracid being produced subsequently by loss of water. AUTHORS.

349. Electrical Conductivity of Alkali Metal Solutions in Liquid Ammonia. L. Farkas. *Zeits. f. phys. Chem.* 161. *Abt.A.* 3–4. *pp.* 355–361, *Sept.*, 1932.—The dependence of the conductivity of solutions of the alkali metals in liquid ammonia upon the concentration is developed from theoretical considerations. The theoretical results are compared with those obtained by direct measurements. A satisfactory agreement is obtained when a lattice arrangement of the atoms of the alkali metals in ammonia is assumed. The conductivity is considered to take place by the non-mechanical transport of the electrons from one alkali atom to the other. F. J. B.

350. Theory of Surface Conductivity. J. J. Bikerman. *Zeits. f. Elektrochem.* 38. *pp.* 763–764, *Oct.*, 1932.—Reference is made to the work of McBain and Dubois on the Smoluchowski formula [see Abstract 656 (1932)]. In the present paper this formula is further examined. J. K.

351. Equal Electrical Conductivities of Moving and Stationary Surfaces: Laing Paradox. R. Dubois. *Zeits. f. Elektrochem.* 38. *pp.* 764–769, *Oct.*, 1932.—Reference is made to the work of McBain and Dubois [see Abstract 656 (1932)], where the Laing formula for electrokinetic and surface conductivity is considered. It is shown that the surface conductivity in general depends on the specific conductivity of the solid wall and upon the conductivity due to the moving ions of the electrical double layer. The specific conductivity of a glass surface is determined when it is in contact with an electrolyte solution and when it is in contact with a stearic acid film floating on water. It is shown that the specific conductivity of the solid surface is 13 to 46 % of the total surface conductivity. J. K.

352. Conductivity of Dielectrics After Exposure to X-Rays. M. Bender. *Zeits. f. techn. Physik,* 13. 9. *pp.* 451–452, 1932.—The dielectrics examined were sulphur, paraffin and a mixture of both. Sulphur and the mixture acquired a certain conductivity after an exposure of a few minutes; paraffin acquired about 20 times less; in both cases the resistance obeyed Ohm's law. E. E. F. d'A.

353. Galvanometer with Moving Magnets Rendered Astatic by a New Method. L. Meylan. *Helv. Phys. Acta,* 5. *pp.* 276–295, *Sept.,* 1932. *In French.*—Two types of galvanometer are described, the one being specially sensitive to current, the other to voltage. The sensitivity of the former is $2 \cdot 6 \times 10^{-11}$ ampere for a deviation of 1 mm. at a scale distance of 1 metre, the total period being 10 sec. and the resistance 1960 ohms. The sensitivity of the second is 6×10^{-10} volt for the same deviation and the same period, the resistance being 0·5 ohm. These sensitivities may easily be exceeded. The stability of the zero of these instruments is such that the mean variation of the zero is only 0·1 mm. at a scale distance of 1 m. for a period of 8 sec. Various advantages of these galvanometers are described. They have been used to study the variations in the intensity of magnetisation of a steel disc of constant diameter as a function of the thickness. Unexpected curves are obtained. H. L. B.

See also Abstracts 28, 79, 279.

DIELECTRICS AND CAPACITANCE.

354. Problems of Electric Images in Dielectrics. Part I. J. J. Weigle. *Helv. Phys. Acta,* 5. *pp.* 262–275, *Sept.,* 1932. *In French.*—Image forces play a certain part in thermionic phenomena. The author discusses several problems involving these forces in practical cases; for example, the forces exerted by dielectrics on point charges when there is a discontinuity in the dielectrics, when the dielectric is of spherical shape, when there is a finite layer of dielectric, and when the dielectric is non-homogeneous. H. L. B.

355. Dipole Moments of Naphthols. M. Puchalik. *Acad. Polonaise Sci. et Lettres, Bull. Nos.* 1–7*A. pp.* 22–33, *Jan.–July,* 1932.—The electric dipole moments of α-naphthol and β-naphthol are determined for the first time by means of the resonance method. It is found that the β-form produces a greater moment than the α-form. The moment of α-naphthol is considerably less than that of phenol, and that of β-naphthol is less than those of the alcohols. Experiments by other workers appear to show, however, that in the case of the nitro- and halogen-derivatives the α-substitution in the naphthalene nuclei produce the same dipole moment as in the benzol nucleus; on the other hand the β-substitution clearly leads to greater moments, approximating rather to those of aliphatic compounds. An interpretation of this behaviour in terms of structural theory is demanded. H. L. B.

356. Dipole Moments of Unsaturated Compounds. Part I. I. M. A. Bruyne, Rosa M. Davis and P. M. Gross. *Phys. Zeits.* 33. *pp.* 719–724, *Oct.* 1, 1932.—Data are given for a large number of ethylene and acetylene derivatives which indicate that the previous assumption of a zero moment for the $=C-H$ group is probably incorrect and that 0·5 is more accurate. The following group moments appear valid: $C-C_6H_5$, $\mu = 0$; $C-Cl$, $\mu = 1{\cdot}56$; $C-Br$, $\mu = 1{\cdot}50$; and $C-NO_2$, $\mu = 4{\cdot}0$. The effects of double and triple bonds on the C—H union are discussed at length. H. H. Ho.

357. Dielectric Constant of Ethyl Alcohol Vapour. H. L. Knowles. *J. Phys. Chem.* 36. *pp.* 2554–2566, *Oct.*, 1932.—The usual heterodyne beat method was used for determining the dielectric constant of ethyl alcohol vapour. Parts of the apparatus are described briefly and the method of calibrating the series condenser is discussed. Dielectric data were taken at a number of different temperatures over complete ranges of pressure. Except in the vicinity of the saturation pressure, $3(K-1)/(K+2)$ was found to vary linearly with p', the ideal vapour pressure. Near saturation the slopes of the K/p curves increased quite markedly. The magnitude of this deviation was found to vary considerably with the solid insulators used in the test condenser. The value of the electric moment as determined from the slopes of the power parts of the K/p curves is $1{\cdot}68_6 \times 10^{-18}$. This value agrees closely with Miles' value of $1{\cdot}69_6$, and seems definitely to rule out Sanger's value of 1·11. Complete data were taken of the d.c. resistance of the test condenser at the various temperatures and pressures. The resistance was found to decrease rapidly near the saturation vapour pressure. Theoretically this lowered leakage resistance is shown to be insufficient to account directly for the abnormally high dielectric constant values near saturation. E. E. F. d'A.

358. Saturation State of a Dipole Liquid in the Neighbourhood of an Ion. S. Oka. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 441–450, *Sept.*, 1932. *In German.*—For purposes of this calculation the series of the Langevin-function $L(x) = 1 - 1/x + 2e^{-2x} + 2e^{-4x} + \ldots$ is used, and the expression already found by Herweg for the decrease in the dielectric constant is confirmed. H. H. Ho.

359. Dipole Moments and Molecular Structure. Part III. Oxychlorides of Sulphur. J. W. Smith. *Roy. Soc., Proc.* 138. *pp.* 154–161, *Oct.* 1, 1932.—The work now described is a continuation of a general investigation [see Abstract 3855 (1932)] and measurements of the dielectric constants and densities of benzene solutions of thionyl chloride and sulphur chloride at 25° and 45° C. are recorded, together with the refractive indices and densities of the same solutions at 13° C. From these data the corresponding molecular polarisations and molecular refractions have been calculated. The electric moments calculated from the change in the molecular polarisation with change in temperature are $1{\cdot}38 \times 10^{-18}$ and $1{\cdot}64 \times 10^{-18}$ respectively; and those calculated from the molecular polarisation at 25° and the molecular refraction are $1{\cdot}58 \times 10^{-18}$ and $1{\cdot}86 \times 10^{-18}$ respectively. The discrepancy between these two series of values indicates either that the atomic polarisations of these molecules is high (about 13·2 c.c. for thionyl chloride and 18·1 c.c. for sulphuryl chloride) or that the dipole moment of these compounds increases with rise of temperature. The results are discussed with reference to the related series diphenyl sulphide, diphenyl sulphoxide and diphenyl sulphone.

H. H. Ho.

360. Electric Moments of Esters of Fatty Acids. C. T. Zahn. *Phys. Zeits.* 33. *pp.* 730–731, *Oct.* 1, 1932.—Data are recorded at different temperatures for ethyl formate and acetate, amyl formate and acetate and methyl acetate, which show no temperature variation of the electric moment. The esters in this respect therefore behave similarly to their acids in that free rotation about the C—O axis is hindered, although certain differences are indicated. H. H. Ho.

361. Dependence of Dipole Moment Measurements on the Solvent. H. Müller. *Phys. Zeits.* 33. *pp.* 731–732, *Oct.* 1, 1932.—An apparatus is described and dipole measurements are recorded for chlorobenzene in the solvents: hexane, cyclohexane, decalin, CCl_4, benzene, tetrachloroethylene and CS_2. Although the differences found are too small for a chemical interpretation, yet the data indicate some dependence of polarisation on the solvent which is tentatively ascribed to orientation. H. H. Ho.

ELECTROCHEMISTRY.

362. Effect of Applied Voltage on Electrolysis in Residual Current Range. G. H. Damon. *J. Phys. Chem.* 36. *pp.* 2497–2503, *Sept.*, 1932.—The effect of applied voltage on the magnitude of the residual current was investigated. The measurements were carried out at reduced pressures. It was shown that the magnitude of the impressed e.m.f. had a marked effect on the magnitude of the residual current. At voltages above 0·5 volt the residual current was a function of the applied potential, at low voltages the residual current was practically independent of the potential. The relationship between the residual current in air and *in vacuo* was investigated for five different potentials. F. J. B.

363. Transference of Water. Part II. Its Dependence on Concentration and Temperature in the Electrolysis of Sodium Chloride Solutions. G. Davies, N. J. Hassid and Millicent Taylor. *Chem. Soc., J. pp.* 2497–2503, *Sept.*, 1932.—Migration experiments have been made with *M* and 0·5 *M* aqueous NaCl solutions at 0°, urea being used as non-electrolytic reference substance to enable the water-transport to be estimated. The results confirm the earlier conclusion [see Abstract 1257 (1930)], that transference of water to the kathode increases with increasing dilution at a rate altogether too great to be accounted for by change in the transport numbers of the ions. Moreover, transport of water to the kathode increases with fall in temperature; this effect also cannot be referred to change in transport number of the kation, this decreasing with fall in temperature. Since activity considerations point to a total ionic hydration which is independent of concentration, the results must be interpreted as indicating that, during migration, the ions transport a considerable quantity of water with which they are not chemically combined. T. H. P.

364. Photographic Study of the Growth of Electrolytic Striations. R. Taft and O. R. Bingham. *J. Phys. Chem.* 36. *pp.* 2446–2454, *Sept.*, 1932.—A photographic record of the growth of electrolytic striations of copper produced in the presence of gum arabic is presented. The formation and growth of these striæ are explained by assuming adsorption of a gum arabic-copper hydroxide complex upon the surfaces of the electrodeposited crystals of copper. The kathode polarisation of copper is increased by the presence of gum arabic. H. H. Ho.

365. Formation of Tantalum in Non-Aqueous Solutions. P. Schupp. *Zeits. f. Elektrochem.* 38. *pp.* 774–777, *Oct.*, 1932.—The conditions for the forming of tantalum in the very carefully dried alcohols have been investigated. Various difficulties are encountered which do not appear when aqueous solutions are used and the means for overcoming these are described. It is found that the maximum voltage varies greatly with the nature of the solvent and is in some cases extremely low. Arguments are advanced which tend to show that such voltages are not true maximum voltages in the sense of the term as used by Güntherschulze and Betz [see Abstract 2897 (1931)]. The thickness of the layer of oxide is determined only by the forming voltage and, within the region investigated, is proportional to this voltage. The absolute thicknesses of the oxide layers are the same as those attained in aqueous solution. T. H. P.

366. Electrolytic Production of Sodium Persulphate. O. Essin and E. Alfimowa. *Zeits. f. phys. Chem.* 162. *Abt.A.* 1–2. *pp.* 44–52, *Oct.*, 1932.—The simple theory applicable to the production of ammonium persulphate is not valid in the case of sodium persulphate, as in the acid solution used Caro's acid (H_2SO_5) is formed, of which the anions discharge at the anode and react with the formation of an excess of SO_4'' ions, which in turn discharge with liberation of oxygen. An equation for the current yield is derived on the assumption that the number of SO_5'' ions which discharge is proportional to their relative concentration and to the number of collisions with oxygen on the surface of the anode; it is in good agreement with results obtained experimentally with constant current-density but with electrolytes of various compositions. H. F. G.

367. Electrolysis of Fused Acetates and Propionates. G. B. Moorhouse. *Faraday Soc., Trans.* 28. *pp.* 766–776, *Oct.*, 1932.—The electrolysis of melts of mixtures of lithium, sodium and potassium acetates, in molar proportions 7:10:10, is shown to follow a course similar to electrolysis of aqueous solutions. The reaction was carried out at 200° C., but complete absence of water is not claimed. 1:1 molar proportions of lithium and sodium propionates was found to be the eutectic. Electrolysis of it gives ethylene in addition to the normal products, butane and carbon dioxide, which also occurs in aqueous solution. Various anodes were used. It is concluded that there is no transitory formation of peroxides, but that the reaction proceeds by the interaction of discharged ions. A. S. C. L.

368. Ionisation of Organic Acids. H. M. Smallwood. *Am. Chem. Soc., J.* 54. *pp.* 3048–3057, *Aug.*, 1932.—From a consideration of the free energy change consequent on ionisation the relation $\log (K_a/K_a') = e(\Phi - \Phi')/2{\cdot}3kT$ is deduced, where K_a, K_a' are the ionisation constants of acids HA and HA′, Φ, Φ' the potentials due to the group moments of the anion calculated at the point occupied by the H nucleus in the undissociated molecule, and e the charge on the H^+ ion. This gives results of the right order for formic acid and methyl alcohol. The calculated value of $\Delta E - \Delta E'$ (the change in energy of ionisation), $-e(\Phi - \Phi')$, is then compared with its observed value, $2{\cdot}3RT \log (K_a/K_a')$, for 27 varieties of A and five of A′, and the considerable discrepancies and assumptions made discussed, as also the effect of temperature. It is concluded that change in ionisation of an organic acid caused by substitution is at least largely due to change in electrostatic repulsion or attraction between the H^+ ion and the dipoles of the anion of the acid. C. A. S.

369. Transport Number of Gold in a Gold Amalgam. K. Schwarz. *Zeits. f. phys. Chem.* 161. *Abt.A.* 3. *pp.* 231–232, *Aug.*, 1932.—A 0·1 % gold amalgam was electrolysed at 25° C. using 1 ampere. The gold moved to the kathode. The transport number is calculated to be $2 \cdot 8 \times 10^{-7}$. F. J. W.

370. Preparation and Reproducibility of the Quinhydrone Electrode. J. L. R. Morgan, Olive M. Lammert and Margaret A. Campbell. *Am. Electrochem. Soc., Trans.* 61. *pp.* 405–426; *Disc.*, 426, 1932.—Details are given for the preparation of the quinhydrone half cells so that they can be used as secondary standards with great precision. The solutions recommended were either 0·1 *N* HCl, or a mixture of 0·01 *N* HCl and 0·09 *N* KCl, saturated with quinhydrone. Results showing the reproducibility are given, and emphasis is laid on the fact that while under the optimum conditions the quinhydrone electrode is an instrument of precision, under many given conditions the results are capricious. Its use as a secondary standard rather than as a working electrode is recommended. F. J. B.

371. Iron as a Hydrogen Electrode. E. Liebreich. *Zeits. f. phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 97–112, *Aug.*, 1932.—It is shown that the potential of iron is dependent in a striking manner on the H-ion concentration. At low H-ion concentrations the dependence is in an opposite direction to that of a hydrogen electrode whereas at higher H-ion concentrations the dependence is similar to that of a hydrogen electrode. At higher H-ion concentrations, for example in HCl having a concentration greater than 1/1250 *N*, the potential differences obtained approach more and more that of a hydrogen electrode. The reversal of the p.d. of iron is clearly shown by measurements of the p.d.s in HCl. The reversal of potential takes place approximately at −0·43 volt. J. K.

372. Influence of Gases on the Normal Potential of the Zinc Electrode. F. H. Getman. *J. Phys. Chem.* 36. *pp.* 2655–2663, *Oct.*, 1932.—The effect of air, oxygen, nitrogen and hydrogen on the potential of Zn immersed in solutions of $ZnCl_2$ was studied. The Zn electrode consisted of a single crystal of high purity metal. The initial value of the potential was found to be increased by air, nitrogen and hydrogen, and to be decreased by oxygen. The influence of each gas on the potential was found to diminish with time. The deviation of the potential from its " normal " value caused by oxygen fell off exponentially with time. The change of potential produced by the different gases was less than the corresponding changes produced by the same gases when the metal was immersed in a solution of KCl. F. J. B.

373. Deposition Potential of Mercury on Metallic Electrodes. T. Erdey-Grúz and H. Wick. *Zeits. f. phys. Chem.* 162. *Abt.A.* 1–2. *pp.* 63–70, *Oct.*, 1932.—The potential at which the deposition of mercury commenced was calculated from the velocity of formation of the mercury nucleus, and found to be −0·34 volt. The comparison was with the reversible potential of mercury in the same solution. The theoretical results were compared with the measurements of the deposition of mercury on electrodes of carbon, tantalum, platinum and gold. The deposition potential was lower on platinum and tantalum than on carbon. F. J. B.

374. Electrode Potentials and Chemical Reactivity. L. Kahlenberg. *Science*, 76. *pp.* 353–358, *Oct.* 21, 1932.—The paper deals with a survey of the various published work on the relationship between electrode potentials and chemical reactivity. Gas electrodes are dealt with, and the lines for further work on different aspects of the problem are indicated. F. J. B.

375. Anodic Behaviour of Nickel. Part II. K. Georgi. *Zeits. f. Elektrochem.* 38. *pp.* 714–731, *Sept.*, 1932.—The rates of change of the potential of nickel anodes in solutions of *N*-nickel chloride, bromide, sulphate, perchlorate and phosphate, at various values of pH, have been measured. The greater the current density and the size of the anion, and the lower the H-ion concentration and the temperature, the more rapid is the disappearance of the diffusion layer on the anode and the appearance of a higher potential. At low current densities nickel dissolves from certain active points, *e.g.*, at the edges and corners of the crystals, whilst the remainder of the surface behaves in the same manner as a platinum electrode, *i.e.*, a deposit of hydrogen is formed thereon until the reversible potential of the metal is attained. In a second condition of the electrode a protective film of nickelic hydroxide is formed on the surface, and the potential is approximately that of the nickelic ion, whilst in a third condition a porous deposit of peroxide is formed. The influence of the initial condition of the surface and of traces of halogen ions on the anodic behaviour of the metal in sulphate solutions have been studied. [For Part I see Abstract 5361 (1932).] H. F. G.

376. Measurement of Overvoltage. A. L. Ferguson and G. M. Chen. *J. Phys. Chem.* 36. *pp.* 2437–2445, *Sept.*, 1932.—An oscillograph-commutator system is described that is very well adapted to the study of transient electrode phenomena. Oscillograms are given showing changes in various potentials during charge and discharge intervals, and also affording a direct comparison of the polarisation potentials as determined by the commutator and direct methods. The work now recorded confirms the earlier conclusion [see Abstract 3502 (1932)] that difficulties inherent in the commutator render the commutator-potentiometer system undesirable for the measurement of overvoltage and transfer resistance. H. H. Ho.

See also Abstract 109.

ELECTRONS AND PROTONS.

377. Measurements of the Charge on Selenium Particles at High Gas Pressures. E. Wasser. *Zeits. f. Physik*, 78. 7–8. *pp.* 492–509, *Oct.* 12, 1932.—Measurements with selenium particles dispersed in an inert gas at pressures up to 30 atmospheres, at which the mean free path is very small, show that the charges on all the particles approximate to that of the electron, and provide no evidence in support of the view that smaller charges exist; many of the particles, however, exhibit deviations from the normal structure and density of the material in bulk, and previous reports regarding the existence of smaller charges than that of the electron are attributed to such deviations. H. F. G.

378. Most Probable Values of e, e/m and h. K. Shiba. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 385. *pp.* 97–121, *Oct.*, 1932. *In English.*—Absolute measurements of X-ray wave-lengths by Bäcklin, Bearden and Cork all yield values for the electronic charge *e* which are slightly larger than Millikan's oil-drop value. The author argues that the latter value is in error and must be corrected to take account of more recent determinations of the viscosity of air. He also shows that the X-ray value of e yields values of h by various methods with sufficient agreement. The simultaneous determination of the most probable values of e, e/m and h is undertaken with the following results: $e = (4 \cdot 803 \pm 0 \cdot 004) \times 10^{-10}$ e.s.u.; $\left(\frac{e}{m}\right) = (1 \cdot 7605 \pm 0 \cdot 0010) \times 10^{7}$ c.g.s. e.m.u.; and $h = (6 \cdot 624 \pm 0 \cdot 007) \times 10^{-27}$ erg. sec. W. S. S.

379. Magnetic Moment and Moment of Rotation of the Electron. L. de Broglie. *Comptes Rendus,* 195. *pp.* 577–578, *Oct.* 3, 1932.—Attention is directed to the fact that the usual expression for the ratio of the magnetic moment of the rotating electron to its moment of rotation, *i.e.*, $-e/m_0c$, is not invariant in a Lorentz transformation, and is not valid for all systems of reference. A correspondence between the respective operators corresponding to the magnetic and electric moments of the Dirac electron, as ordinarily interpreted, is shown to be unsatisfactory for three reasons, and it is pointed out that satisfactory correspondence can be derived if the proper mass, m_0, of the electron in classical mechanics plays the same rôle as the operator $-a_4m_0$ in Dirac's theory. In connection with previous work [see Abstract 4802 (1932)], it is pointed out that a luminous wave can be conceived as the result of superposition of equal energy waves of opposite signs. This conception, however, introduces the difficulty that the frequency of the electromagnetic field would be double that of the Ψ wave. J. S. G. T.

380. Inelastic Electron Scattering in Gases. C. B. O. Mohr and F. H. Nicoll. *Roy. Soc., Proc.* 138. *pp.* 229–244, *Oct.* 1, 1932.—The angular distribution of inelastically scattered electrons has been investigated in He, A and Hg vapour for the angular range between 20° and 160°. The scattered electrons of different energies are sorted by a uniform radial electrostatic field. In He, scattering curves are obtained showing small and large angle scattering for 54, 83, 120 and 196-volt electrons. Comparison with theoretical curves based on Born's formula shows that at high voltages there is good agreement, but the theory fails for elastic collisions at small angles and for both types of scattering at large angles; it fails also when the voltage is reduced. Angular distributions are obtained in A for 42- and 61-volt electrons and in Hg vapour for 21-, 31-, 42-, 55-, 83- and 120-volt electrons. At the higher voltages, maxima and minima occur in the inelastic curves, which are similar to the corresponding elastic curves, but at lower voltages, in Hg vapour, the similarity gradually disappears. For lighter atoms, consideration of electron exchange energy and of wave distortion by the atomic field, finally lead to results in agreement with experiment. For heavier atoms, however, the experimental results indicate that for both elastic and inelastic electron scattering, it is merely the " size " of the atom which is of fundamental importance.

F. C. C.

381. Scattering of Slow Electrons. E. Feenberg. *Phys. Rev.* 42. *pp.* 17–32, *Oct.* 1, 1932.—The scattering equations derived in an earlier paper [see Abstract 3402 (1932)] are here found by a variation method, which is closely related to the Fock-Slater method of determining single electron functions for complex atoms. The equations for scattering in helium and the other inert gases are treated in detail and put into a form suitable for numerical integration. For scattering in helium excellent agreement with experiment is found in the neighbourhood of the resonance potential; at 10·75 volts the agreement is poor. This discrepancy at low potentials is undoubtedly to be accounted for by atomic distortion which is neglected in the scattering equation. AUTHOR.

382. Reflection of Fast Electrons from Single Crystals. H. Raether. *Zeits. f. Physik,* 78. 7–8. *pp.* 527–538, *Oct.* 12, 1932.—In contrast to X-rays it is found that in the case of the reflection of monochromatic electron rays from single crystal surfaces a large number of reflection points occur in the form of a crossed grid of interferences. Rotation of the crystal round the normal to the reflecting surface causes a marked change in the number of reflection points. Examples are given of the effects obtained with crystals of pyrites, zinc sulphide and rock-salt. An accurate method is given for the measurement of the internal potential, which up to the present has always been found to have a positive value. Intensity measurements are recorded and the results are discussed in relation to the dynamic theory. A. W.

See also Abstracts 89, 92, 171, 179, 236.

ELECTROSTATICS.

383. Frictional Electricity. E. Hess. *Zeits. f. Physik,* 78. 7–8. *pp.* 430–444, *Oct.* 12, 1932.—The author examines artificial amber, ebonite, fused quartz and Jena glass, and uses the quartz as a standard substance owing to its constancy of shape, and its spherical surface is pressed into contact with the other substances in the form of flat plates. The area of contact, according to Hertz, is $5F = p^{2/3} . \pi . k$, where p is the contact pressure. Coehn's first rule, that dielectrics of high dielectric constant are positively charged in contact with dielectrics of low dielectric constant, is confirmed throughout. The second rule, according to which the charge is proportional to the difference between the two dielectric constants, is confirmed for glass after allowing for the film of water condensed on the surface. E. E. F. d'A.

384. H.T. D.C. Generator. R. E. Vollrath. *Phys. Rev.* 42. *pp.* 298–304, *Oct.* 15, 1932.—When powdered materials are blown through metal tubes by means of compressed air considerable quantities of electricity are produced by contact electrification. It was found that 6×10^{-5} coulomb could be produced per gm. of diatomaceous earth, a form of silica, blown through a short length of copper tube. A generator of extremely high voltage is proposed, and a small-scale model of such a generator is described, by means of which currents of 8×10^{-5} ampere at 260 kV were generated. AUTHOR.

See also Abstract 214.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstract 387.

MAGNETISM AND ELECTROMAGNETISM.

385. Magnetic Behaviour of Isotropic Ferromagnetic Materials. R. Gans. *Ann. d. Physik,* 15. 1. *pp.* 28–44, *Oct.,* 1932.—A theoretical and mathematical discussion of the magnetic constants, and their relationships, for single crystals of Ni, Fe and Co. The study is deduced from fundamental issues and based upon knowledge of crystal structure. The curves of magnetisation for strong and weak fields are fully discussed. S. G. B.

386. Magnetic Effects in Iron Crystals. A. G. Hill. *Phil. Mag.* 14. *pp.* 599–604, *Oct.*, 1932.—The form of the curve of magnetisation for iron crystals has been suggested to consist of bends linked by straight lines, although continuous. The cause has been attributed to some quasi-regular rearrangement of the elementary magnets within the crystal and the present work is a study of the phenomena involved. After a description of experimental details and a record of results it is concluded that (*a*) there is a sharply defined initial linearity of the magnetisation curve at all temperatures for fields less than 2·0 gauss, and there is no magnetic lag therein; and (*b*) apart from the very flat initial stage, for temperatures between −190° and 162° C. for fields up to 20·0 gauss, the shape of the curve is consistently non-linear the lower the temperature the greater the magnetic lag. S. G. B.

387. Spontaneous Magnetisation and Thermo-Remanence in Ferromagnetic Single Crystals. J. Koenigsberger. *Phys. Zeits.* 33. *pp.* 763–767, *Oct.* 15, 1932.—In the neighbourhood of the Curie point for very small values of the field-strength, an apparent equilibrium condition of the spin obtains, which, in a zero field at lower temperatures, when the coercive force is extraordinarily great, is remanent and does not disappear, and in consequence of decreasing temperature disturbances exhibits itself more strongly. As earlier observations show, by extrapolation, in a zero field at the Curie point no spontaneous magnetisation is created, and furthermore the phenomenon is also not associated with crystallising out at low temperatures. The spontaneous magnetisation due to reversible causes, etc., affords in real crystals a measurable factor of energy in comparison with the coercive force. S. G. B.

388. Materials of High Magnetic Susceptibility. F. Stäblein. *Zeits. f. techn. Physik*, 13. 11. *pp.* 532–534, 1932.—Experiments are described upon the measurement of the coercive force by means of a ballistic galvanometer and also the magnetic values of iron-nickel alloys as will as the effects of the special additions of silicon. The effect of heat expansion upon a 36 % nickel steel is also observed. The apparatus described is designed to give great precision in the measurement of small coercive forces and a number of technically valuable alloys of iron, nickel, silicon, as also pure iron are examined. S. G. B.

389. Variation of Principal Magnetic Susceptibilities of Certain Paramagnetic Crystals with Temperature. B. W. Bartlett. *Phys. Rev.* 41. *pp.* 818–837, *Sept.* 15, 1932.—The Curie and Weiss constants were determined over the range 60° to −45° C. for five crystals of the isomorphic monoclinic double sulphate series containing cobalt, nickel or copper, and for cobalt sulphate heptahydrate. The Curie constants for the principal susceptibilities of any given crystal are very nearly the same, but the Weiss constant shows considerable variation, not only in the same crystal, but also from one crystal to another. Both constants decrease progressively as the metal ion is changed from cobalt to nickel to copper. There is a small continuous change in the orientation of the principal magnetic axes in the plane of symmetry of the crystal with respect to the crystallographic axes as the temperature is varied. G. E. A.

390. Establishment of a Homogeneous Magnetic Field. A. Bühl and F. Coeterier. *Phys. Zeits.* 33. *pp.* 773–774, *Oct.* 15, 1932.—The establishment of a homogeneous magnetic field without the aid of iron is difficult where high intensities and homogeneity are required. Usually long coils with small diameter are used. Limitations of dimensions of the coil, etc., effect limitations correspondingly in the range of homogeneity. The theoretical case of ellipsoids which would give a strong homogeneous field is difficult to achieve in practice, and the conical coils are often inconvenient. The present paper describes a theoretical case, mathematically, where homogeneity of field, etc., can be attained by the use of a relatively short cylindrical coil, and one or two coaxial auxiliary coils of suitable dimensions. The formulæ evolved give the necessary data for the estimation of the size of such auxiliary coils. By means of the arrangement suggested a homogenous field was obtained using a coil 40 cm. long and 6 cm. dia. over a range of 10 cm. length and 5 cm. breadth, wherein the variation of the field differed from the mean value by less than 7/100,000. S. G. B.

391. Magnetic Field of a Solenoid Oscillating at Radio Frequencies. O. Stuhlman, Jr., and S. Githens, Jr. *Rev. Sci. Instruments,* 3. *pp.* 561–571, *Oct.,* 1932.—The question considered was whether the magnetic field under radio-frequency excitation is analogous to the field obtained in the same coil when excited by d.c. Two characteristic oscillator circuits were employed at frequencies varying from 1500 to 6000 kc. Three typical, loosely wound solenoids were examined. It was found that the configuration of the internal magnetic field of a loosely wound single-layer cylindrical coil depends on the type of oscillating circuit employed. A symmetrical push-pull oscillating circuit gives a symmetrical field similar to that obtained with d.c. excitation. The flux intensity distribution along the axes of the three solenoids when driven by the tuned plate-tuned grid oscillator was not symmetrical; the position of maximum intensity was always near the filament end of the solenoid. At least to the first approximation the field-strength when a push-pull oscillator is used has a distribution of intensity along the axis of a solenoid that conforms to the d.c. field. As to distribution of field-strength across the diameter of a solenoid a curve showing results is given. As the end of the coil is approached the slopes of the curves showing the inside distribution gradually decrease in the ratio of 1 : 0·95 : 0·80. J. J. S.

392. Bearing of Earth's Permeability on Self- and Mutual Inductance by Coils Wound on its Surface. W. F. G. Swann. *Phys. Rev.* 41. *pp.* 649–666, *Sept.* 1, 1932. *Frank. Inst., J.* 214. *pp.* 481–486, *Oct.,* 1932.—The mutual induction of two parallel circular loops wound as small circles on the earth in such a manner that their distance apart is equal to their radius varies from 2·8 h. for $\mu = 1$ to 11 h. for $\mu = \infty$. The self-induction of a circular loop wound as a small circle on the earth and of radius equal to half that of the earth varies from 79·8 h. for $\mu = 1$ to 167 h. for $\mu = \infty$. Solutions of other problems are given.

G. E. A.

393. Significance of the Sign of Mutual Inductance. R. R. Nimmo and H. D. Poole. *Cambridge Phil. Soc., Proc.* 28. *pp.* 531–537, *Oct.* 31, 1932.—Reference to standard text-books reveals a confusion with regard to the meaning of the sign of a mutual inductance. It is shown that it is necessary to give the direction of the current in order to give a meaning to this sign. In many cases it is possible to replace the mutual inductance by a quantity which is numerically equal to the mutual inductance but

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which is independent of the direction of the current. Examples of the application of this method are given. J. E. R. C.

394. Effect of Strain on Magnetostriction and Magnetisation in Nickel. C. W. Heaps. *Phys. Rev.* 42. *pp.* 108–118, *Oct.* 1, 1932.—With a heterodyne beat method, magnetostrictive hysteresis loops have been obtained for a nickel wire under three different tensions. Magnetic hysteresis loops for the same wire and same tensions were also secured. The magnetostrictive contraction dL/L for the tensions 6·82 and 3·70 kg./mm.^{2} is given quite accurately by the equation $dL/L = -1\cdot93 \times 10^{-10}I^2$, where I = intensity of magnetisation. For a tension 0·72 kg./mm.^{2} the equation $dL/L \doteq -1\cdot30 \times 10^{-10}I^2$ holds somewhat less accurately. The effect of compression and of stretch on the residual magnetisation of a nickel wire in a demagnetising field is determined experimentally. From this experiment, and from the magnetostriction curves, it is shown that at certain field strengths the magnetism of a nickel wire, bent elastically into a circular arc, becomes unstable. Thus the large discontinuities in the magnetisation curve observed by Forrer may be explained. It is suggested that the small Barkhausen jumps of magnetisation may be due to similar magnetic instability produced in small regions by local strains. AUTHOR.

395. Magnetostriction and Magnetisation of Single Crystals of the Iron-Nickel Series. F. Lichtenberger. *Ann. d. Physik,* 15. 1. *pp.* 45–71, *Oct.,* 1932.—According to Becker's theory the magnetic properties of ferromagnetic materials are closely dependent on their magnetostriction characteristics. The object of the research here described was to throw some light on this subject by investigating the magnetic and magnetostrictive properties of single crystals of the Fe-Ni series of alloys containing 30–100 % Ni. Alloys with less than 30 % Ni were neglected, since they are technically of little importance and are partially irreversible. Magnetostriction values and magnetisation curves are given for a large number of alloys in the above range. The direction of easy magnetisation was found to be 100 for single crystals in the series 30–71 % nickel and 111 for the series 71–100 % nickel. The exceptional properties of permalloy would appear to be due to it being the optimum mean between the change of direction of easy magnetisation (71 % Ni), the vanishing of polycrystalline magnetostriction (83 % Ni) and the equality of magnetostriction in all directions (85·5 % Ni). A. W.

See also Abstracts 28, 39.

MEDICAL RADIOLOGY AND ELECTROLOGY.

396. Universal Precision Stimulator. O. H. A. and F. O. Schmitt. *Science,* 76. *pp.* 328–330, *Oct.* 7, 1932.—Modern advances in the field of nerve physiology, involving high amplification of the action potential and its visual recording by means of the kathode-ray oscillograph, have revealed that the customary methods of stimulation, especially at high rates, are unsatisfactory. Any method operated by a mechanical key is unsatisfactory since the time of operation varies, especially with appreciable voltage or current. Manual operation is inaccurate beyond frequencies of 50 per sec., and this is of particular importance in relation to threshold responses. Lullies has suggested the use of photoelectric cells in order to overcome this difficulty, but the authors have abandoned this method owing to the extreme difficulty of obtaining quick shocks at low rates of stimulation and because the large capacity between the stimulating circuit and ground makes the system unsatisfactory, especially for use with the kathode-ray oscillograph. The authors then describe in close detail, with a diagrammatic representation of the circuits, a self-excited valve oscillator capable of stimulating at any desired rate, from once every few minutes up to 400 per sec., for details of which the original paper should be referred to. It is pointed out that the circuit described should find numerous applications other than those for nerve and muscle stimulation, *e.g.*, for use with a kymograph, for accurately marking time intervals, etc. B. J. L.

397. Applied Effective Voltage and X-Ray Emission. L. S. Taylor, G. Singer and C. F. Stoneburner. *Bureau of Standards, J. of Research*, 9. *pp.* 561–570, *Oct.*, 1932.—A previous study [see Abstract 5298 (1932)] suggested a parallelism between the applied effective voltage and the emission of an X-ray tube. The investigation has been carried further under more carefully controlled conditions. It is found for two mechanical rectifiers and one " constant potential " generator that the X-ray emission per effective (r.m.s.) mA of tube current is about the same for all generators operating at the same effective (r.m.s.) voltage (the radiation passing through the same filter in all cases). Thus it becomes possible to express all radiations in terms of that excited by constant potential. This leads to a simplification in the description and reproduction of irradiation conditions in biological work. Although the study has been limited to three generators, it is believed that they are sufficiently typical to warrant generalisation. AUTHORS.

398. Radiological and Electrotherapeutic Departments of the St. Louis Hospital and the Laennec Hospital, Paris. L. Vellard. *R.G.E.* 32. *pp.* 341–355, *Sept.* 17, *and pp.* 387–398, *Sept.* 24, 1932.—During the past few years the marked advances in diagnostic and therapeutic radiology and the application of electrical currents under various forms for medical purposes has resulted in the electrical equipment of hospitals being of a very extensive character. After an introduction as to the evolution of medical electricity in general, detailed descriptions are then given of the electromedical departments in the St. Louis and the Laennec Hospitals in Paris, the arrangements of the buildings being discussed, and descriptions are given of the particular electromedical apparatus installed. B. J. L.

OSCILLATIONS.

399. Spontaneous Generation of Oscillations in Low-Pressure Discharges. S. K. Mitra. *Phil. Mag.* 14. *pp.* 616–631, *Oct.*, 1932.—Investigates the nature of the oscillations generated in low-pressure discharge in the air when a condenser is connected across the discharge-tube and a high resistance is inserted in series with the h.t. source, in the audible range of frequency between 100 and 1000 p.p.s. Observations on the relations between the frequency of the generated oscillations and (*a*) the current through the discharge-tube, (*b*) the capacity of the associated condenser, (*c*) the pressure within the discharge-tube and (*d*) the separation of the electrodes. These observations generally confirm those made by Gill in the supersonic range of frequency. Discussion of the important part played by the external resistance in the maintenance of the interruptions. Shown that there is a critical value of the resistance below which no oscillations will occur. The value of the critical resistance deduced in terms of the extinction-potential, the internal resistance of the discharge-tube, and the battery voltage; experiments confirm this relation. The wave-forms of the pulsating current flowing in the different branches of the circuit, obtained with a kathode-ray oscillograph, confirm in a general way the charge and discharge theory originated by Righi. Falling-plate photographs of the discharge show that the duration of the discharge is very small compared with the period during which the tube is extinguished, and thus justify the assumption usually made that the discharge is almost instantaneous. A. D.

400. Absorption of the Debye–Falkenhagen Relaxation Force in a Neutral, Partially Ionised Gas. K. F. Niessen. *Phys. Zeits.* 33. *pp.* 705–718, *Oct.* 1, 1932.—An investigation is made of the influence of the Debye–Falkenhagen relaxation force [see Abstract 2817 (1928)] on the absorption of electromagnetic waves in a medium satisfying Langmuir's definition of a plasma. It is concluded that in the Kennelly–Heaviside layer the absorbing effect of the relaxation force can be neglected in comparison with the damping due to collisions and that relaxation resonance is impossible. A. W.

PHOTOELECTRICITY.

401. Photoelectric Properties of Alkali Metal Films. J. J. Brady. *Phys. Rev.* 41. *pp.* 613–626, *Sept.* 1, 1932.—Studies the photoelectric properties of films as a function of their thickness reckoned in monomolecular layers. For potassium, the maximum threshold, approximately 5800 Å. occurred at a thickness of 3 molecular layers, while the maximum total photoelectric emission occurred at 12·4 molecular layers and the photoelectric properties remained constant after 19 molecular layers. For Rb and Cs the values were somewhat smaller. E. E. F. d'A.

402. Electronic Emission of Metals under X-Rays. H. Küstner. *Ann. d. Physik,* 14. 8. *pp.* 857–880, *Oct.,* 1932.—The author gives formulæ for the ionisation of the air as well as the plate in a vacuum. He considers that for the motions of electrons in the metal only the losses of velocity matter, and not the absorption. For the formation of ions in the air, also, the issuing velocities of the electrons are the determining factor. On the other supposition, *viz.,* the paramount importance of electron absorption, the yield of ions would have to be very many times smaller, especially in the case of the slower electrons. E. E. F. d'A.

403. Cæsium Oxide Photoelectric Cells. J. C. Peters, Jr., and E. B. Woodford. *Physics,* 3. *pp.* 172–178, *Oct.,* 1932.—Tests were made to determine the effects of illumination and time upon the sensitivities of thirteen commercial cæsium-oxide photoelectric cells. These included the Westinghouse cells known as the VB and GB, and the General Electric cells known as the PJ-22, PJ-23, PJ-14 and PJ-15. The VB, PJ-22 and PJ-14 are vacuum types, while the others are gasfilled. The effect of ambient temperature upon four of these cells has been measured.

E. E. F. d'A.

404. Copper-Oxide and Photronic Cells. C. H. Bartlett. *Rev. Sci. Instruments,* 3. *pp.* 543–552, *Oct.,* 1932.—Analysis of an approximate empirical expression for current in the Photronic cell indicates the fundamental generator action to be parallel, as in the copper-oxide cell, rather than series as in the conventional generator. Thus current is fundamental, the observed e.m.f. resulting. Using approximate relations, expressions for the maximum power output and power sensitivity for the copper-oxide and Photronic cells are given, as well as for the maximum voltage drop and voltage sensitivity. The widely different behaviour of the internal resistance in the two cells is pointed out, and some of the resulting effects on the respective cell characteristics discussed. E. E. F. d'A.

405. Applications of Photronic Cells. G. A. Shook and Barbara J. Scrivener. *Rev. Sci. Instruments*, 3. *pp*. 553–555, *Oct*., 1932.—Describes the procedure recommended for various miscellaneous measurements, such as the comparison of coloured solutions, the measurement of gloss, and the distribution of light by lampshades. E. E. F. d'A.

406. Blocking-Layer Photoelectric Effects. F. Waibel. *Zeits. f. Physik*, 78. 7–8. *pp*. 423–429, *Oct*. 12, 1932.—Gives various reasons for regarding the currents produced apparently by light in the presence of a blocking layer as primarily thermoelectric. He points out, for instance, that if a current of air at ordinary temperature is directed against the contact the current immediately falls to zero or is even reversed. An e.m.f. rather than a current is generated, and this e.m.f. shows some remarkable analogies to a thermo-e.m.f. **E. Rupp.** *Ibid*. 79. 7–8 *p*. 562, *Dec*. 3, 1932. E. E. F. d'A.

407. Photoconductivity. F. C. Nix. *Rev. Modern Physics*, 4. *pp*. 723–766, *Oct*., 1932.—A general summary of modern knowledge, chiefly based upon the work of Gudden and Pohl. E. E. F. d'A.

See also Abstracts 115, 204, 216, 316, 412.

PIEZOELECTRICITY.

408. Temperature Variation of the Frequency of Piezoelectric Oscillations of Quartz. R. E. Gibbs and V. N. Thatte. *Phil. Mag*. 14. *pp*. 682–694, *Oct*., 1932.—Quartz crystals are tested to find how the temperature coefficient of frequency of vibration for two types of vibration vary at high temperatures, where the elastic effects are well known; especially to find what happens round the transition point. A heterodyne method is essential as the frequency change is small. In both cases a simple hyperbolic relation is found to connect the temperature coefficient with the temperature. H. M. B.

409. Modes of Vibration of Quartz Piezoelectric Plates as Revealed by an Interferometer. W. D. Dye. *Roy. Soc., Proc*. 138. *pp*. 1–16, *Oct*. 1, 1932.—An investigation was made of the modes of vibration of a number of quartz piezoelectric plates using an interferometer. The quartz plate rested on a brass disc and above it a glass plate rested on the ends of three levelling screws and carried on its under side a grid of fine wires serving as the upper electrode. Interference fringes were produced by light reflected from the under surface of the glass plate and from the upper surface of the quartz plate, and the type of fringes, their width and inclination to the edges of the quartz plate could be varied by suitable manipulation of the levelling screws. With the quartz plate at rest the fringe pattern is uniform, but when the quartz vibrates the fringes are blurred in all parts of the surface which are in motion. The modes of vibration may thus be studied in detail and illustrations are given of typical modes of circular and of rectangular plates excited in fundamental and in harmonic modes. At the frequency corresponding to the thickness of the plates it is found that some portions of the surface do not take part in the vibration and that the amplitude of the vibrating portions varies very much from point to point of the surface. Synchronous intermittent light was also used in the interferometer and it was thus found that the motion of the vibrating quartz plate is non-uniform not only in amplitude, but also in phase, which may differ by as much as 180° between various parts of the surface. Photographs of vibrating quartz plates taken with intermittent light were utilised to construct, by an ingenious application of a pantographic engraving machine, contour maps of the vibrating surface of the quartz plate. A number of these are reproduced photographically. A. W.

410. First Piezoelectric Modulus of Quartz from Determinations with a Quartz Resonator. Angelika Székely. *Zeits. f. Physik*, 78. 7–8. *pp.* 560–566, *Oct.* 12, 1932.—A change of condenser capacity and conductance accompanies the excitation of oscillations in a quartz resonator provided the frequency of the oscillations corresponds approximately with that of the quartz dielectric. The magnitude of these changes can be determined from the resonance curve and suffices to determine the first piezoelectric modulus and the damping coefficient of quartz. J. S. G. T.

THERMIONICS.

411. Exit Work of Electrons from Metals. I. Tamm and D. Blochinzev. *Zeits. f. Physik*, 77. 11–12. *pp.* 774–777, *Sept.* 3, 1932.—Neglecting the image force, and treating the metal as a continuous semi-infinite solid of positive electricity in which electrons are free to move, the Hartree–Fock wave mechanics method of self-consistent field can be used to derive the exit work of the electron. The value zero is obtained. The same method can be used to find the exit work attributable to the image force, and the results obtained for the alkali and alkali earth metals show general agreement with the experimental values. W. S. S.

412. Thermionic and Photoelectric Work Functions of Molybdenum. L. A. DuBridge and W. W. Roehr. *Phys. Rev.* 42. *pp.* 52–57, *Oct.* 1, 1932.—The photoelectric and thermionic emission from pure Mo was studied during a prolonged process of outgassing by heat treatment at temperatures up to 2100° K. In a sealed-off tube an equilibrium condition was reached which was not changed by further treatment extending up to 1600 hours. Photoelectric curves taken at room-temperature and at 940° K. and analysed by Fowler's method yielded a true work function for the outgassed Mo of $4\cdot15 \pm 0\cdot02$ volts. Thermionic data for the same specimen also yielded a work function of 4·15 volts, and a value of the constant A close to the theoretical value of 60 ampere/cm.^{2} deg.^{2}. AUTHORS.

413. Emission from Hot Tungsten. P. B. Moon. *Cambridge Phil. Soc., Proc.* 28. *pp.* 490–496, *Oct.* 31, 1932.—Measurements have been made of the positive ion currents emitted by tungsten at temperatures between 3000° and 3200° K. The results are in general accordance with the values calculated on the basis of the Saha equation from the rate of evaporation of neutral atoms, the electron work-function and the

ionisation potential of tungsten. The "work-function" associated with the ionic evaporation appears to lie between 10 and 11 electron-volts.
E. E. F. d'A.

414. Vacuum Fats. W. Espe and I. Kroczek. *Zeits. f. techn. Physik*, 13. 9. *pp.* 443–446, 1932.—The emissivity of oxide kathodes is a most sensitive test for the soundness of the fat used to make the junctions airtight. The vapours due to Ramsay fat, for instance, exert a considerable effect upon the work of emergence of electrons. They may even stop them altogether. The vacuum fat devised by Burch is not open to that objection.
E. E. F. d'A.

See also Abstracts 316, 336, 354, 414.

THERMOELECTRICITY.

415. Theory of Thermoelectricity. B. Bružs. *Zeits. f. Elektrochem.* 38. *pp.* 777–779, *Oct.*, 1932.—A proof is given of the postulate previously brought forward by the author from the solution of the Ludwig–Soret problem, and successfully employed in the questions of the concentration polarisation, the concentration circuit and the diffusion. According to this postulate with stationary conditions (as in the case of the Seebeck effect) the reaction heats occurring in the stationary system exhibit latent (secondary) heats. It is further shown that this arrangement is sufficient not only to establish the relationship of the thermoelectric effects but also to give a thermodynamic explanation of the Peltier effect.
J. J. S.

416. Thomson Effect in Crystalline Substances. Y. Endô. *Tokyo Univ. Aeronaut. Research Inst. Report, No.* 85. *pp.* 145–149, *Sept.*, 1932. *In English.*—By calculation of the work against the internal balancing e.m.f. as well as the energy of electrons dissociated in the metal the formula for the Thomson effect is deduced. This formula is applied to the cases of Cu, Ag, Au, Al and Pb, compared with Borelius' observed values, and the percentage of dissociated electrons estimated. For Cu, Ag, Au, metals of the first group of the periodic system, it is given by $A_0T^{\frac{3}{2}}$, for Al, a metal of the third group, by $A_0T^{\frac{3\cdot3}{2}}$, and for Pb, a metal of the fourth group, by $A_0T^{\frac{2\cdot6}{2}}$; these values approximating to those expected from Richardson's theory of thermions. The formula gives the value of σ at any temperature. Applying the second law of thermodynamics, the coefficient of the Peltier effect P is given by the formula: $\sigma_B - \sigma_A = T\frac{\partial}{\partial T}\left(\frac{P}{T}\right)$, where T is the absolute temperature at the junction, and σ_A and σ_B are coefficients of the Thomson effect of the two metals at T. But σ_A and σ_B are zero when $T = 0$, and thus P is also zero and hence

$$P = T\int_0^T \frac{\sigma_B - \sigma_A}{T}dT.$$

Thus using the above formula for σ the Peltier effect can be calculated.
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